

Case Snell
G

BARRETT -
HAMILTON

BRITISH
MAMMALS

INSECTIVORA

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INSECT-EATING MAMMALS.

THE five British members of this order are comprised in four genera, viz. :—*Talpa*, represented by the Mole ; *Erinaceus*, by the Hedgehog ; *Sorex*, by the Common and Pygmy Shrews ; and *Neomys*, by the Water Shrew. Of these the Hedgehog and Pygmy Shrew are alone found in all three sections of the kingdom. The Mole, Common Shrew, and Water Shrew, although common in Great Britain, are unknown in Ireland.

These four genera are typical of as many families, and since in dealing with them there arises no question of super-generic importance affecting British natural history, it seems best to shorten the introduction to this order and to omit all technical descriptions of the families. This course leaves more space for the ampler treatment demanded by more difficult groups, such as bats, rodents, seals, and whales.

To non-technical eyes the British insectivora, excepting the shrews, present few points of resemblance, and even the characteristic to which they owe the name of their order is not absolute, since, although restricted as a whole to a diet of invertebrates, they have no objection to attack and devour the higher animals when an opportunity occurs. In fact, the Hedgehog is in this respect a frequent, the Water Shrew an habitual, offender ; and for the others, the limits of their menu are probably in this respect governed rather by their lack of power than by any lack of relish for flesh. As mentioned in detail under the various species, some insectivores will even eat vegetable matter, when no other food is available.

Each family consists of a highly specialised and ancient group, with no near allies of any sort in Britain.

The semi-blind, burrowing Mole, its whole frame adapted for a life spent in pursuit of earthworms ; the comparatively inactive Hedgehog, hunting its humble prey in the midst of enemies, and relying for its own safety on the passive defence of a coat of spines ; and the shrews, always lively and alert whether on land or water—are each unique types in the British fauna. The shrew and the Mole are active throughout the year, whereas the Hedgehog undergoes at least a partial hibernation during the colder months.

The Pygmy Shrew is remarkable for being the smallest non-volant British mammal, and in this respect it has few rivals, and none outside its own order, throughout the world.

Shrews, hedgehogs, and moles are well known in literature, and stand for well-defined and characteristic types in the public mind.

Besides the genera mentioned above as British, there are found in continental Europe, the white-toothed shrews of the sub-family *Crocidurinae*, which are numerous in species and widely distributed in Asia and Africa. The desmans (genus *Desmana*, Göldenstädt, 1777, ante-dating *Mygale*, G. Cuvier, 1800, and *Galemys*, Kaup, 1829), which were formerly more widely distributed and included Britain in their range, are now in Europe confined to southern Russia, with the Pyrenees and the Iberian Peninsula, where there are at least two species. They are inhabitants of streams and rivers, and their habits are said to resemble those of the water rats, with the difference that they feed, not on vegetable matter, but on invertebrates.

The order insectivora is extremely old, being of pre-Pliocene age, both in Europe and America. Further details will be found under the several genera and species.

TALPIDÆ.

TRUE MOLES.

GENUS TALPA.

1758. TALPA, Carolus Linnæus, *Systema Naturæ*, x., 52; xii., 73, 1766: based on *T. europæa* of Linnæus, and *T. asiatica* of Linnæus.

In Britain this genus includes only the well-known *T. europæa*, the type of its genus, of form and habits so characteristic as to require few words of description.

True moles are burrowing insectivores, with the body cylindrical, short limbs and tail, and immense hands; with abundant velvety fur set vertically in the skin; with eye and ear very much reduced or entirely absent as external organs; with the head, which is used for turning up the earth, tapering to the extremity of the slender, flexible, and sensitive snout.

The **arm** is modified so as to form a powerful digging organ; the radius and ulna are well developed, short, and strong; the humerus and clavicle are short and broad, the latter particularly so, thus bringing the arm well forward. The hand is very broad and flat, and, when digging, faces outwards, not downwards (Plates I. and II., Fig. 1); it cannot be closed, but by inclination of the terminal phalanges forms a very efficient hoe; its great breadth arises principally from a special development of the proximal inner wrist-bone or radial sesamoid, a large curved ossicle known as the *os falciforme*. All five fingers are present and carry strong, acutely-pointed claws, which are firmly embedded in the elongated terminal phalanges. The other phalanges are much shortened. In the hind limb the tibia and fibula are united, and there is no pubic symphysis. The foot is comparatively small and weak, but all five digits are present. The intestine is without a cæcum.

The **skull** is elongated and possesses auditory bullæ and slender zygomatic arches but no post-orbital processes.

There are forty-four **teeth**, an exceptional number for a recent species, but regarded as typical for the primitive placental mammalia. They are arranged as follows:—

$$i \frac{3-3}{3-3}, \quad c \frac{1-1}{1-1}, \quad pm \frac{4-4}{4-4}, \quad m \frac{3-3}{3-3}.$$

The chisel-shaped incisors are disposed in a semicircle; the median upper pair are slightly larger than their fellows, the lower are not extended forwards horizontally as in the shrews. The long and conical upper canine is double-rooted. Then follow three small, subequal, double-rooted premolars; the fourth is larger and more in series with the three molars, of which the second is largest and has seven cusps, two internal and five arranged as an external **W** (compare

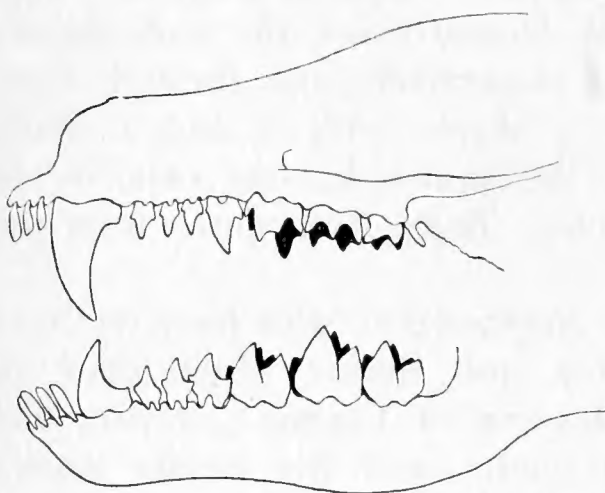


FIG. 1.—SIDE VIEW (diagrammatic and magnified $2\frac{3}{4}$ times) OF TEETH OF *Talpa europæa*.

Plate II., Fig. 1A, Vol. I., p. 124). In the lower jaw the canine is indistinguishable from the incisors, and the anterior lower premolar is enlarged to take its place. The premolars are small, but increase in size from the front backwards. The last molar, the smallest of its series, is comparatively larger than that of the upper jaw.

True moles are almost confined to the temperate regions of Europe and Asia, from Great Britain through the Himalaya and Altai ranges to the mountainous parts of Assam and Burma, where they reach at least 10,000 feet (Blanford). The best known species after *T. europæa*, is Savi's *T. cæca* of south Europe except Spain, where is found *T. occidentalis* (Cabrera), a smaller animal with functionless eyes and shorter snout; Thomas's *T. romana*, a large-toothed form, was described from the neighbourhood of Rome, Italy (*Ann. and Mag. Nat. Hist.*, December 1902, 516-517). Others, such

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as Milne-Edwards's *T. longirostris* of western China and Tibet, the short-tailed *T. micrura* of Hodgson from the south-western Himalayas, and *T. altaica* of Nikolski, from the Altai, are little known. In all, except *T. europæa*, the eyes are said to be covered by a membrane.

The genus is unrepresented in Africa, where its place is taken by the golden moles or *Chrysochloridæ*; and in the new world. In the latter the four allied genera, *Scalops*, *Scapanus*, *Parascalops*, and *Condylura* (see True, *Proc. U.S. Nat. Mus.*, xix. [No. 1101], 1-112, 1896), have the first upper incisor much larger than the second. *Talpa* is connected with *Sorex* through *Urotrichus* and *Neiurotrichus*, the mole-shrews of Japan and North America respectively, and through *Uropsilus* of Tibet, the latter a shrew with a mole's skull. Remains of moles occur in the upper Eocene deposits of Europe (*Protalpa*), and the genus *Talpa* itself dates from the Miocene period.

Other allied genera are:—*Scaptochirus*, with forty teeth, of China, Mongolia, Asia Minor, and Syria; *Parascaptor* of Indo-China to Tibet, and *Mogera* of Formosa, Japan, and Siberia, each with forty-two teeth; and the hardly known *Dymecodon* of Japan (see Thomas, *Proc. Zool. Soc.*, London, 4th February 1908, 51, footnote).

THE COMMON MOLE, MOLDWARP OR WANT.

TALPA EUROPÆA, Linnæus.

- 1758. *TALPA EUROPÆA*, Carolus Linnæus, *Systema Naturæ*, x., 52; xii., 733, 1766; and all authors, except as below; described from Upsala, Sweden.
- 1776. *TALPA FRISIUS*, P. L. S. Müller, *Natursystems Supplements und Register Band*, Suppl., 36; described from Ost-Friesland.
- 1777. *TALPA EUROPÆA*, α *ALBO-MACULATA*, J. C. R. Erxleben, *Systema Regni Animalis*, i., 117; described from Ost-Friesland.
- 1785. *TALPA VULGARIS*, P. Boddaert, *Elenchus Animalium*, i., 126; from Brisson, renaming *T. europæa*.
- 1789. *TALPA EUROPÆA*, β *VARIEGATA*, J. F. Gmelin, *Systema Naturæ*, i., ed. xiii., 110; based on a colour-variety.
- 1789. *TALPA EUROPÆA*, γ *ALBA*, J. F. Gmelin, *loc. cit.*; based on a white variety.
- 1792. *TALPA EUROPÆA NIGRA*, Robert Kerr, *Animal Kingdom*, 200; apparently renaming *T. europæa*.

1792. TALPA EUROPÆA CINEREA, Robert Kerr, *loc. cit.*; based on a cinereous variety.

1797. TALPA EUROPÆA RUFA, J. M. Bechstein, *Der Zoologe*, i., v.-viii., 13; described from southern France.

La Taupe of the French; *der Maulwurf* of the Germans.

Terminology:—The name “mole,” written as *molle* or *mulle*, only appears, according to the New English Dictionary, in Middle English, having been borrowed from Middle Dutch *mol* or *molle* about 1398. This would imply an independent derivation from *mul*, the root of mould, from the Indo-germanic root *mel* = to grind, so that *mulle* meant the “grinder” or “crumbler.” But the latter view is only problematic, since there is some evidence to show that “mole” may after all be an English word. Thus, the forms *mallan* or *mullan*, which are given as Irish by O’Reilly, can only have been derived from a similar Anglo-saxon form, since the animal itself did not occur in Ireland.

In any case, the forms *mole* and *moldwarp*, though they come from the same original root, and have been confused in usage, are two totally different words. The two parts of the name *mold-warp* (*molde* = mould, and *weorpan* = to throw) certainly existed separately in Anglo-saxon, although the compound itself has not been discovered. On the other hand, where the word *mold* occurs at a later period, it is not necessarily an abbreviation of *mold-warp*, but may be an independent extension of the form *mole*.

An early and unknown translator (about 1420) of Palladius (*Husbandrie*, Early English Text Society, 108, iv., 130) has:—

“The molde, and other such as diggeth lowe.”

Spenser (1553-1598) uses only *mouldwarp*, but Shakespeare employs both forms, as in *Hamlet*, I., v., 162:—

“Well said, old mole! canst work i’ the earth so fast?”

and again in *Henry IV.* (III., i., 149):—

“He angers me

With telling me of the moldwarp and the ant;”

so that the abbreviation, or extension, of the word, whichever view be taken, was of early date. On the other hand, Topsell (1607) has both *mole* and *want*.

Want, *woont*, or *wunt*, which is variously corrupted into *oont*, *hunt*, *wuntit*, etc., is derived, obviously, from Middle English *wont* = a mole, which stood, undoubtedly, for an older form, *wand*, and came from the same root as Anglo-saxon *windan* = to wind. The form *wand* is found in the most ancient English document in existence, viz., the

Epinal Glossary, which has been attributed to about 700 A.D. This is in the Mercian, *i.e.*, Anglian, dialect, but the Saxon form must have been identical with the Anglian, as is known from the history of similarly formed words.

Sex names:—Boar and sow.

Local names (non-Celtic):—*Moldwarp* or *mouldwarp*; *want* or *wunt*; with innumerable corruptions, of which formidable lists are given in Wright; these are explained under Terminology.

(Celtic):—Irish — *caochán* = “blind one.” Scottish Gaelic — *famh-thalmhainn* (*ath-thalmhain*); *dallag* = “blind one”; *dubh-threobhaiche* = “black ploughman”; *nìr-threobhaiche* = “mould-plougher.” Manx — *kyaghan* = “blind one”; *roddan-ooirey* = “earth-rat”; *lugh-ghoal* = “blind mouse.” Welsh — *gwadd*; *twrch daear* = “earth hog”; *twrch gorddodyn* = “burrowing hog”; older form, *ylyr*. Cornish — older, *god*; later form, *godh*, *gúdh*.

Mole-hills are known as want-heaves or tumps in various parts of England, both heave and tump being terms having, according to Wright, the general meaning of “heap.”

Distribution :—The Common Mole, possibly including forms hitherto undistinguished from it, ranges through boreal and transitional Europe and Asia, from sea-level to about 6000 feet in the Alps (Blasius); and from Scotland, to in Sweden about 59° N. lat. (but not in Norway), the middle Dvina district in north Russia, and corresponding latitudes of Siberia to central France; it there gives way to *T. cæca*, as well as in Dalmatia, Greece, and in most countries south of the Alps. In Spain it is replaced by *T. occidentalis*, and in the neighbourhood of Rome by *T. romana*. Eastwards the limits of its distribution are imperfectly known, but it occurs from Great Britain to probably the Pacific coast of Siberia. In western China, Tibet, the south-western Himalayas, and the Altai it meets other species, already mentioned on p. 5.

In **Great Britain** the Mole is probably abundant in every county of England, Wales, and Scotland.

It is numerous even in Sutherland and Caithness (Harvie-Brown and Buckley), in the former of which Selby reported it as common in 1834 (*Edinburgh New Phil. Journ.*, xx., 159, 1836). The evidence of Scottish naturalists is, however, in favour of a general recent increase in its numbers with a corresponding extension of its range, and there are stated to be areas, such as Southend, Kintyre (Boyd Watt), which it has not yet reached.

Wherever the soil permits or earth-worms are found, it ascends to the summits of the highest hills, as in Yorkshire (Roberts, *Zoologist*, 1872, 3182-3183). It has been observed at altitudes of 1700 feet, or practically the highest point, on the Pentlands, and even higher on the Ochils (W. Evans), while in the Solway and

Clyde areas, and in Wales, it has been detected by Service, Boyd Watt, and Forrest at 2000 feet at least in each case, the first observer recording its presence at 2782 feet on the Merrick (*Trans. Edinburgh Field Naturalists' and Microscopical Society*, vi., i., 64, 1907-8). Boyd Watt has found it at 1200 feet, when the snow-line was 200 feet below. For the Tay area it has been recorded from 1500 feet (Godfrey in Harvie-Brown), and its workings occur at well over 2000 feet on the Loch Tay hills (Evans *in lit.*). On the other hand, its burrows may be found in the sand-dunes by the sea beach, as at Thurso, Caithness (Kinneir), at North Berwick, Haddington (Evans), and elsewhere; at Malldraeth and elsewhere in Anglesey it even frequents ground flooded by spring tides (Oldham in MS.; see also Forrest).

From the islands it is as a rule absent, but occurs in Jersey (Bunting, *Zoologist*, 1908, 461) and Alderney (Eagle Clarke); is common in Wight (More; Bury; Wadham); and numerous in Anglesey (Coward). In the Clyde Isles and Inner Hebrides it is known only from Bute, whence Pennant reported it in 1777 (see also W. Evans, *Ann. Scott. Nat. Hist.*, 1905, 241); Ulva, off Mull, where it is stated to have first appeared in February 1892 (Harvie-Brown and Buckley); and Mull, where it is numerous and its presence is locally attributed to a legendary introduction in a boatload of earth sent from Morven early in the eighteenth century (Alston). Remains found on Ailsa Craig were probably carried there by predatory birds (Boyd Watt).

Despite its absence from the Shetlands, Orkneys, Outer Hebrides, Man, and Ireland,¹ it is known by a Gaelic name to the inhabitants of the two latter islands.

Distribution in time :—A species from the Cromer Forest Bed (late Pliocene) hitherto referred to *T. europæa*, in reality belongs to another and extinct species. The fossil remains which are found in British late Pleistocene deposits, such as the Ightham Fissures in Kent and the Teesdale caves in Yorkshire, represent a form much more closely related to the living *T. europæa* than the older Forest Bed species.

The **rutting season** is normally confined to the end of March, April, and, occasionally, part of May. The **period of gestation** is about four weeks, or slightly more. The **young**, averaging between three and four, with extremes of one and seven, are born normally from about the 24th April to the middle of June. Occasionally late litters have been observed in August or September, but there is no evidence that the Mole breeds twice a year (Adams, *Mem. and Proc. Manchester Lit. and Philosoph. Soc.*, xlvii., No. 4, 23, read 18th Nov. 1902 (1903)).

¹ A bird's "pellet" picked up in Benevenagh Woods, Bellarena, Co. Londonderry, by R. Welch, was found by Adams to contain the skull of a mole, perhaps brought over by a hawk from Scotland (*Irish Naturalist*, 1905, 72).

Description:—The general form and appearance of the Common Mole are typical of its genus.

The **eye** is set low down and far forward. The small eyeball has a diameter of about 1 m.; the irides are dark brown, the pupil circular (see Davy, *Proc. Zool. Soc. (London)*, 1851, 129-131). The eye is relatively more prominent in the fœtus (Geoffroy, also Bruton, *Manchester Mem. cit. supra*, xlvihi., 1904, No. 20). There is neither orbit nor eyelash, and the small external aperture, about 1 m. in diameter, can only doubtfully be said to possess an eyelid. The ear is without any external conch. The fingers are short, with all the phalanges about equal in size.

The very soft, short, silky **fur** covers the whole body down to the feet and hands, but on the scaly tail is reduced to a few long stiff hairs. It shines like iridescent velvet, so that the **colour**, which at the first impression appears to be pure black, varies according to the direction from which it is viewed; it is bright grey when seen in the direction in which the hairs lie, and rich deep black from the opposite point of view; a slight yellowish tinge appears on the lower jaw and along the middle of the belly. There is much individual variation, both as to general colour and amongst the individual hairs, which may have the tips and bases of different shades.

Little is known as regards **seasonal variation** or **moult**; the latter takes place, perhaps as in the shrews, twice a year, namely, in spring and autumn. Service (*Trans. Edinburgh Field Naturalists' and Microscopical Society*, vi., i., 64, 1907-8) states that the winter coat is changed immediately after the breeding season, the male preceding the female by several weeks, but both sexes have usually assumed their new coat by the first week of June. Adams's observation of a mole shedding its coat in May (*in lit.*) is corroboratory.

The **young** at birth are pink and hairless, but as they increase in size the skin grows darker, assuming a dark slate-blue colour before the fur begins to appear (see also p. 12).

The number of **mammæ** is probably variable. The most usual number is believed to be six, but Adams (*op. cit.*, Fig. 28) has figured a specimen having eight, placed in pairs along the entire pectoral and inguinal surface. They are not readily seen even when the female has young.

Genital organs:—Without dissection it is difficult to distinguish the sex of immature animals. Until the first breeding season, the vagina is imperforate and the clitoris closely resembles a penis.

At the end of January the uterus and vagina of the female, and the testes, prostate, and corpus spongiosum of the male undergo considerable enlargement, attaining a maximum at about the end of March or beginning of April, when pairing takes place. After this date

the organs decrease, and by the end of May have returned to their minimum size, which they retain for the rest of the year (Adams, *op. cit.*).

The **skull** and **teeth** are typical of the genus.

Individual colour variation is very frequent. The most usual types may be arranged in three classes, viz., (1) true pink-eyed albinos; (2) those with yellow or whitish markings; (3) ashy or silver grey.

Class 1—Absolutely white specimens with pink eyes are almost or quite unknown, but there are on record a cream-coloured one from near Eton (Clark-Kennedy, *Zoologist*, 1867, 702) and an "orange-pink" male, with dusky shading on the back, from Somerset (Garnett, *Field*, 21st June 1902, 978), each with pink eyes.

Class 2 includes numerous individuals displaying almost every form of gradation from wholly whitish, but not absolutely white, to normal, with orange, yellowish, or whitish markings. These markings most usually take the form of a patch or streak on the throat or abdomen, and in such cases there are usually a few whitish hairs on the feet and tail (see Service's figures, *Ann. Scott. Nat. Hist.*, 1903, pl. i.). In many of the wholly cream-coloured forms, the throat and under side are more or less completely tinted with rich orange and ferruginous hues, which may extend to the limbs, cheeks, nape, or dorsal line (Southwell, *Zoologist*, 1888, 22). Variations of the above type are so numerous that they can hardly be styled abnormal. They are often confined to definite areas (Service; see also Perkins, *Field*, 10th April 1909, 641), and in some localities, as near Oby and Clippesby in Norfolk (Southwell, *Trans. Norfolk and Norwich Nat. Soc.*, iii., 25th March 1884, 667), and on Gullane Links, Haddington (W. Evans, *in lit.*), they are common, and appear to be restricted to certain families, in which all the young of a litter may be affected.

In some cases associated with the above type the tips of the hairs remain of a dusky colour, although the bases are light (Aplin, *Zoologist*, 1882, 351). In a female described by Service (*Ann. Scott. Nat. Hist.*, 1904, 66), the general colour was glossy slate-black, with suggestions of plum-blue on the upper side; the light hair-bases were restricted to the under side. In another example, sent for examination by Forrest, all the hairs were bicoloured, with the bases on the right side only of the body tinted with orange; the central abdominal region, a throat-patch, and a band running across the head between the eyes and snout, were also orange.

Pied or skewbald varieties, other than as described above, are quite rare; one is stated to have had two white spots on the back, the white hairs being of unusual length (Ford, *Zoologist*, 1882, 263); as was also the case with one from Bristol (Charbonnier); others were cream or orange coloured, mottled or striped with black (Cordeaux,

Zoologist, 1868, 1186; Prior, *Journ. cit.*, 1877, 225-226); one had a white head (W. Evans); in another the nose and tail were tipped with white, and there was a white breast-spot (Forrest); while J. Whitaker has figured one which was largely cream colour with dark underside and head, the lines of demarcation being of irregular course (*Scribblings of a Hedgerow Naturalist*, 1904, 238).

Class 3—Ash, or mouse-coloured, silvery-grey, and bluish-lead specimens are occasionally met with, but are not common (see Tomes, *Vict. Co. Hist.*, Worcestershire, 174; Larken, *Zoologist*, 1890, 97-98; Crewe, *Field*, 25th February 1893, 296; Service, *Ann. Scott. Nat. Hist.*, 1908, 117). Adams writes me that he possesses an ash-coloured specimen caught at Penistone, Yorkshire, and W. Evans reports a fawn-coloured one taken at Gullane, Haddington, in November 1910, also a beautiful silvery-grey variety taken near Edinburgh in February 1911 (*in lit.*).

The sex of animals varying in colour is seldom given by recorders, and even when stated is not always reliable, field naturalists being frequently in error in judging the sex of moles. Service, however, states that in cream-coloured specimens the female is always lighter than the male (*Zoologist*, 1893, 425). This writer's articles on variation may be consulted for further information, as may be Harting, *Field*, 19th July 1902, 141.

The Common Mole seems to be very free from **geographical variation**, but Matschie (*Sitzungs-Berichte der Gesellschaft Naturforschender Freunde* (Berlin), 1901, 9, 229) suggests that the Roumanian form differs from that of central Germany; and Rollinat and Trouessart (*Comptes rendus Soc. Biol.* (Paris), 15th December 1906, 602) state that in France, towards the southern limit of its range, the degree of development of the eye is variable, and that frequently no external eye is visible. They conclude that the disappearance of the eyes has taken place recently, and that it is connected with the stronger light of the south. Satunin has described a subspecies, *T. e. brauneri*, from south Russia, but I have not been able to examine it.

William Evans believes that individuals inhabiting the upland districts of the Edinburgh district are on the average rather larger than those of the lowlands.

DIMENSIONS IN MILLIMETRES.

Ten specimens in British Museum.	Head and body.	Tail (without terminal hairs).	Hind foot (without claws).
Maximum . . .	147	32	21
Average . . .	139	27·7	19·2
Minimum . . .	122	20	16

The above dimensions are taken from the labels, and rest on the

authority of the various collectors. The sex of the specimens has not been given here, as such determinations are frequently unreliable. Service (*Trans. Edinburgh Field Naturalists' and Microscopical Society*, vi., i., 64, 1907-8) states that males are larger than females, the maximum total length known to him for each sex being about 195 and 156 respectively, but these figures were quite exceptional, and the average for females would be about 140. Adams also finds males larger; adults measured by him have had the head and body varying between 140 and 127, while young in the nest have reached 118. Three females averaged for head and body 133, tail 33, and hind foot 20.

The table following, for which I am indebted to Adams, indicates the rate of growth of young examined in the nest from the first to the twenty-second day after birth (see also *Mem. and Proc. Manchester Lit. and Philosoph. Soc.*, liv., 2, 9, 1909):—

Number of days old.	Head and body.	Tail.	Hind foot.	Colour.	Remarks.
1	42	8	5	Very red	Umbilical cord unhealed.
2	47	9	5·5	Red	Do.
5	62	10	8	Pink.	..
7	{ 70 71	{ 12 15	{ 9 9	{ Pink.	..
9	80	15	11	Slightly lead coloured on back only.	..
11	{ 88 91	{ 16 17	{ 12 13	{ Lead coloured above, lower parts pink.	..
12	95	16	14	Do.	..
14	105	17	16	Lead coloured all over; fur just visible.	..
17	114	23	16	Completely clothed with velvety, lead-coloured fur	Ears open.
21	117	25	17	Fur approaching normal colour and length	Eyes showing spot of matter, but not yet open.
22	118	27	16·5	Fur almost normal . . .	Eyes opening.

Skull:—Condylar basal length, 34 to 36; greatest breadth at zygoma, 12 to 13; greatest breadth of brain-case, 14·8 to 17·8; greatest inter-orbital breadth, 8·2 to 8·8; breadth of rostrum over canines, 4·8 to 5; depth of brain-case through bulla, 10·2 to 10·6; length of mandible, 22 to 23·4; length of upper tooth-row, excluding incisors, 12·8 to 13·4; length of entire lower tooth-row (alveolar), 13 to 13·2.

Weights:—Eagle Clarke sends me the following weights in grammes of thirteen Scottish specimens taken near Edinburgh:—81·6 (19th September); 74·5 (3rd October); 121·5, 112·7, 110·8, 101·7, 95·2, 91, 88·5, 86, 82·2, 77·5, 68·5 (9th November). Several were no doubt immature, but, since 100 grammes=3·6 oz., the larger measurements agree with Aflalo's statement that the average weight of adults is just under 4 oz. One weighed by Kinnear reached 80·64 grammes.

Few of our native mammals have supplied more material for fancy writing to authors of works on natural history than the subject of this article, many pages of imaginative admiration having been devoted to it. Difficulties of observation have no doubt much to do with this. At any rate, paragraphs are published expressing commiseration with the poor creature's life of incessant toil in subterranean darkness, and rapture at its form and the peculiarities of its structure. Surprise is expressed at its wonderful adaptation to its mode of life, and minute descriptions are added of the well-nigh mathematical plans upon which its under-ground home and habitations are supposed to be constructed.

Amongst so much fiction,¹ to which authorities of such weight as Blasius, MacGillivray, and Bell contributed each their quotum, it is difficult to find the truth. Indeed, were it not for the recent studies of Messrs William Evans² and Lionel E. Adams,³ the compiler's task would have been most unenviable. Few accurate observations were previously on record. Gilbert White almost ignored the animal, and other early writers were unacquainted with its habits.

For the first detailed account of the life of the Mole, we are indebted to Henri le Court, who originally held a lucrative situation at the French Court, but retired from the horrors of the Revolution into the country, to devote himself to the study of this animal and of the most efficient means for its extirpation. Le Court imparted his knowledge to his friend and pupil Antoine Alexis Cadet de Vaux, who published a small book on the subject in 1803.⁴ Mr Adams thinks that this interesting

¹ A paper in the *Field* of 11th July 1908, 90-91, wherein Colonel R. F. Meysey-Thompson quotes largely from a mole-catcher, is a good example of the prevailing intermixture of correct and incorrect observations.

² First published in 1892 in *Proc. Roy. Phys. Soc.*, Edinburgh, Sess. xi., 1890-1891, 85-171, read 15th April 1891. I am also indebted to Evans for many unpublished original observations of which I have made free use.

³ "A Contribution to our Knowledge of the Mole (*Talpa europæa*)," *Mem. and Proc. Manchester Lit. and Philosoph. Soc.*, xlvii., 4, 1-39, read 18th November 1902 (1903); "Observations on a Captive Mole (*Talpa europæa*)," *Journ. cit.*, l., 9, 1-7, read 10th April 1906 (1906); also, "Some Notes on the Breeding Habits of the Common Mole," *Journ. cit.*, liv., 2, 1-9, and plate, read 19th October 1909 (1909). Adams has also favoured me with his note-books containing many supplementary observations of great value and interest, the whole of which he has placed at my disposal, and has, besides, rendered assistance by reading the MS. of this article.

⁴ *De la Taupe, de ses mœurs, deses habitudes, et des moyens de la détruire* (Paris, 1803).

work is on the whole a trustworthy record of Le Court's observations, although here and there the writer has allowed considerable play to his imagination.

Le Court's studies attracted the attention of the celebrated naturalist Étienne Geoffroy, who visited him for the purpose of ascertaining the truth and extent of his discoveries, and subsequently copied most of de Vaux's essay for his own work, published in 1829.¹ Geoffroy's account of the animal may be divided into two parts, in one of which he reproduced de Vaux; in the other he published the results of his own anatomical studies. The former, in which the imaginative parts unfortunately occupy a prominent position, has been the happy hunting-ground of most subsequent writers; the latter, although interesting and valuable, has been frequently ignored. Verification of de Vaux's statements has been but seldom attempted, but Bingley's account of the animal may be mentioned as still readable and instructive. An extraordinary and amusing, but original, treatise is that of the Rev. James Grierson, who, writing in 1821 to 1822, transcribed the information imparted to him by a mole-catcher.²

A great many of the myths surrounding the natural history of the Mole were exploded by Mr Adams's classical paper, the results of four years' study in the neighbourhood of Stafford. This paper will no doubt for long form the model of future accounts of the animal.

The Mole is essentially a burrowing animal, spending nearly all its time under-ground, and feeding, almost but not exclusively, on the earthworms which it meets in its tunnelling. It follows that its form and limbs are highly specialised for the fulfilment of a peculiar existence, from the ordinary routine of which there is but little variation, and which is accompanied by curious and interesting instincts.

The general form of the body is calculated to facilitate its rapid progress through the subterranean passages which form its habitual routes between the different parts of its domain.

¹ *Cours de l'Histoire Naturelle des Mammifères* (Paris, 1829).

² "Some Observations on the Natural History and Habits of the Mole," by the Rev. James Grierson, M.D., M.W.S., Minister of Cockpen, in *Mem. Wernerian Soc.*, IV., i., 218-236, 1821-22.

The anterior extremities are admirably constructed for the purpose of progression through the soil, while the hind legs are employed in such acts of running or walking as are inseparable even from a miner's existence. The snout is a very important organ, being employed either in acts of prehension, or as the sensitive guide to assist the hands when boring; it is also the seat of what is probably the most highly developed sense the Mole possesses, that of smell. The sense of sight, so important to most animals, would in the present case be useless, at least during by far the greater portion of its existence; and hence we find that it is reduced to its minimum of development, and sacrificed, as it were, to the necessary pre-eminence of that of smell. There can, indeed, be no doubt that to the latter sense the Mole is indebted for the perception of its food, of its enemies, and of its mate; indeed, Mr J. L. Bonhote informs me that a captive in his possession could always detect worms placed at the other side of a wooden partition in its box. At the same time, it appears to be much assisted by the sense of hearing, which, although without the usual aid of an external conch, is certainly very acute. Shakespeare was not unmindful of this fact:—

“ Pray you, tread softly, that the blind mole may not
Hear a footfall : ”

—*The Tempest*, IV., 1, 194.

The interesting question whether the Common Mole possesses true vision, has long been discussed amongst naturalists, whose opinions have no doubt been at times confused by the existence of more than one European species of the genus. The eyes of Savi's Mole,¹ which replaces our own in parts of the south of Europe, have no external opening, a fact which is probably responsible for Aristotle's declaration that the Mole is absolutely blind. The eyes of the Common Mole are, however, at least in England, provided with an aperture admitting the entrance of light, and the actual eyeballs and lenses, although very small, are both present and capable of use. This was shown long ago by Geoffroy, and more recently by

¹ *T. cæca*, Savi.

Herr Carl Hess¹ of Germany. The latter denies that the animal is even short-sighted.

But, even allowing so much, it was conceded by Herr Hess that while under-ground the eyes must be quite useless. It is evident that their low forward position in a head, the aspect of which is downwards, not to mention the thick fur surrounding them, and the grass amongst which the animal usually moves when above ground, must combine to restrict the vision, even of acute eyes, to a radius of a few inches. This is entirely borne out by the observations of practical naturalists like E. R. Alston,² Dr H. Laver,³ and Mr Adams, who, although admitting that the eyes appear functional, find from careful observation that they are of little or no service to the animal. Mr Adams is thoroughly convinced that the Mole is practically blind. A captive individual, when confronted with a worm, immediately perceives its proximity and shows signs of excitement. But it invariably has to search for it; and the random way in which it does so until it strikes the worm haphazard, suggests a probable absence of sight. So much was this the case, indeed, with one kept captive by Alston, which "puzzled round" a piece of meat so long before finding it, that he was inclined to disparage its sense of smell also. Although a very slight movement is at once perceived, probably by the sense of hearing, a mole proved absolutely indifferent to the presence of a lighted candle, even when waved about before its face, and would have actually run into the flame if permitted to do so. Mr Adams argues that the animal could hardly be indifferent to such a startling and unfamiliar phenomenon close in front of its eyes, unless the light were imperceptible.⁴

It is probable that the whole controversy has arisen out of an existing variability in the eyesight of individuals. For instance, Messrs R. Rollinat and E. L. Trouessart find that towards the southern extremity of the Mole's range in France the eyes are not infrequently concealed beneath the skin, and

¹ *Nature*, xli., 1889-90, 373, transcribed in *Zoologist*, 1890, 98; see also John Davy, *Proc. Zool. Soc.* (London), 1851, 129.

² *Zoologist*, 1865, 9707.

³ *In lit.*

⁴ But it should be noted that many wild or inexperienced domestic animals apparently take no notice of a light or a fire until they approach near enough to feel the heat. A. H. Cocks finds also that the sense of smell is not normal in animals confined in boxes or cages.

the conflicting reports are very easily intelligible if it is supposed that this variability extends to other districts.

A curious, but true, old story, that the fur around the eyes is sometimes radiated, has been mentioned by many authors, and dates at least from the latter half of the fifteenth century, when Bartholomæus Anglicus¹ wrote: "And some men trow that the skin of the mole breaketh for anguish and sorrow when he beginneth to die, and beginneth then to open the eyes in dying that were closed living." This has been observed by Mr Adams during the spasms of a dying mole, as well as frequently by Dr Laver.² Mr F. A. Bruton³ has noticed that a distinct conical cavity may be formed by radiation of the fur, at the bottom of which the black circular eye was clearly seen by him with no protection whatever.

Everyone has seen on the surface of the ground the evidences of the Mole's burrowing for its food; they are indeed plain almost everywhere in Great Britain, from the sand-dunes and salt-marshes of the sea-shore to the upland pastures and the higher slopes of the mountains. The plan upon which it works has, however, formed the subject of some discussion; by most writers the animal has been endowed with a knowledge of architectural symmetry in the scheme of its tunnels, characteristic rather of an engineer than of a wild animal. The usual idea of the domain, district, or encampment, as it is variously called, is somewhat as shown in Fig. 1, each animal being supposed to confine itself to the actual limits or immediate neighbourhood of its own district. But this cannot really be the case, since a trap placed in a run may catch many more than one. Possibly the truth is that the old males, as in the case of so many other mammals, are more or less solitary, the females and young comparatively sociable.

There is a central habitation or fortress, from which extends a main tunnel or high-road, by which it is supposed that the animal reaches the extremities of its domain, and from which open out numerous minor galleries or excavations. These are the hunting-grounds of the males, and are being continually extended in their search for food. This description, strange to

¹ *De Proprietatibus Rerum*, lib. 18, cap. 100, fol. 1471, English version, 1535.

² *In lit.*

³ *Op. cit. supra*, p. 9.

say, does not apply to the females, which dig their runs in all directions, so as to form no recognisable high-road. This fact was discovered by le Court and verified by Mr Adams. In both types, there are sometimes to be found certain partially or

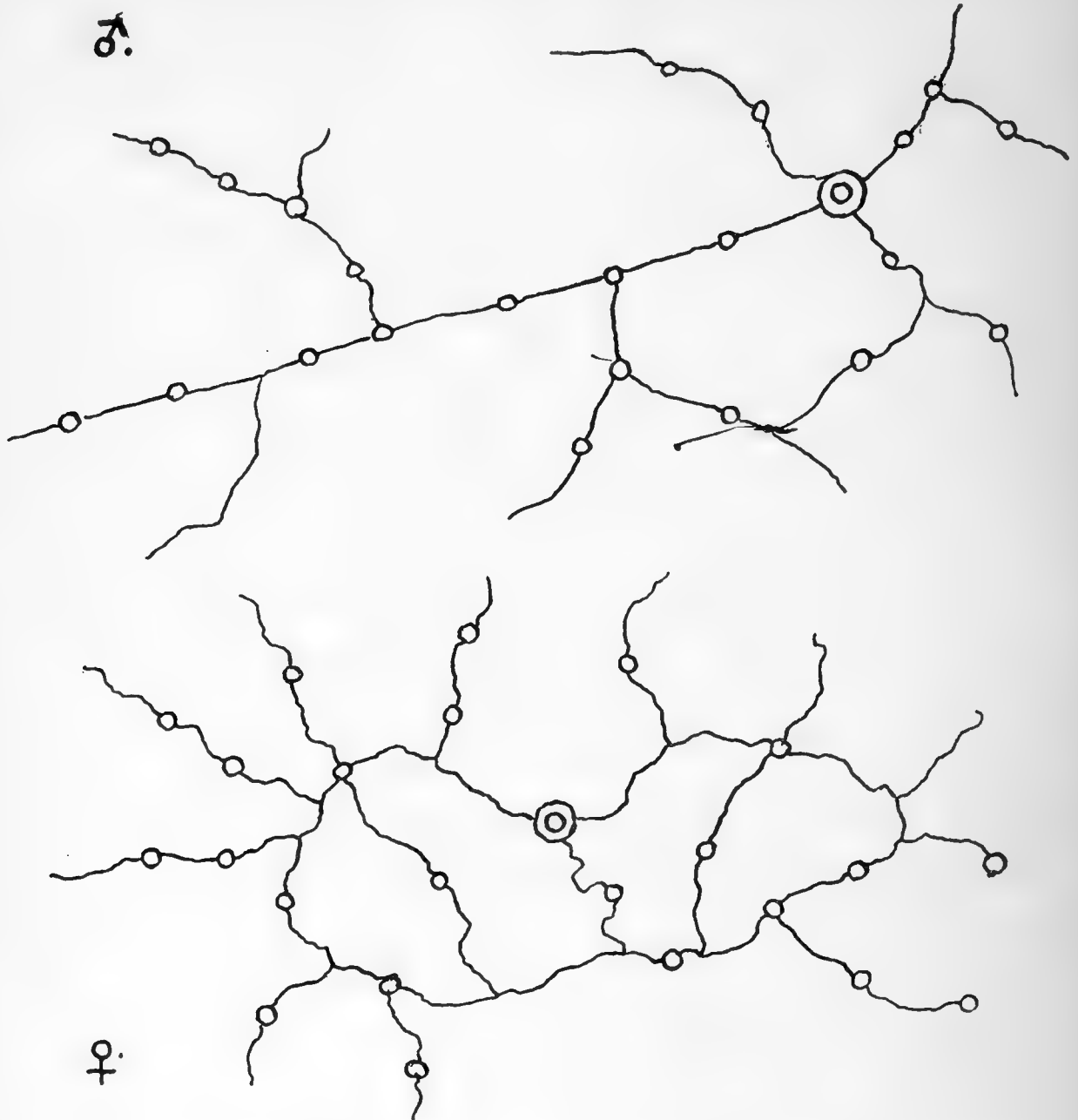


FIG. 2.—ENCAMPMENT OF MOLE. ♂ male, ♀ female, (○) fortress, ~ tunnels, ○ outlets for earth (diagrammatic, after Adams).

completely open surface-furrows, which are usually known as “coupling runs,” “rutting angles,”¹ or *traces d’amour*. These

¹ Angle, a name given to the holes or runs of animals, such as badgers or field-mice, and in some places to artificial burrows used for capturing rabbits in warrens, is not connected with “angle,” a worm for fishing, or “angle-dog,” a Devonshire name for an earthworm (*see* Wright).

are more frequently met with during the pairing season than at other times, but on damp soft land they may occasionally be seen at any time of the year. They may be straight and long (as if the work of a male), having been measured by Mr Adams up to a length of one hundred yards; or much shorter, reaching fifteen to twenty yards only, and tortuous or meandering (suggestive of a female). They are probably the work of an animal changing its district, but whether of an individual in search of a mate or otherwise, has not been determined.

The structure of the fortress was long supposed to be based on an unvarying plan of remarkable symmetry, and most text-books complacently reproduce, apparently without attempt at verification, a stereotyped figure which owes its origin to Geoffroy, with elaborations by Blasius. This figure is largely imaginative, and differs from that presented by de Vaux, evidently as the result of an actual dissection; nevertheless it seems to have met with universal acceptance until Captain Mayne Reid questioned its accuracy.¹ In 1891, Mr Evans, after frequent excavations of "hillocks" in Scotland, confessed his inability to harmonise them with the accepted diagram, and figured the plan of one differing markedly therefrom. Occasionally a close agreement may be observed; but as a rule the departure from the stereotyped form is considerable, a conclusion completely substantiated by that of Mr Adams, formed eleven years later, after carefully drawing numerous fortresses.

Mr Adams's plans show that sometimes the fortresses are extremely complicated and sometimes very simple, but in no case are they, as suggested by the books, built on a pre-arranged system of labyrinthine escapes from enemies above and below. On the contrary, the galleries are rather the natural, incidental, and inevitable outcome of the work of excavating the nest-cavity and piling up the superincumbent mound.

"The site for the fortress having been determined," writes this author, "a circular cavity as a receptacle for the nest is made from two to six inches below the original surface of the ground, except in boggy soil or low-lying land liable to floods, where

¹ *The Naturalist in Siluria*, 124, 1889, wherein are also some other interesting remarks on the Mole, which I should have quoted had I been able to secure a copy earlier.

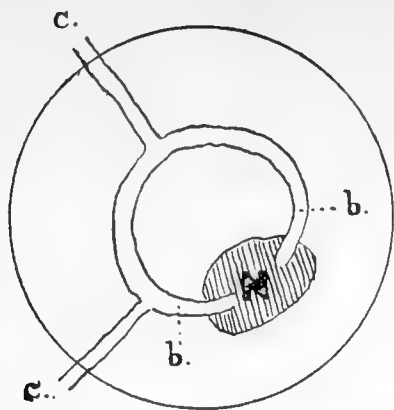


FIG. 3.—PLAN OF TUNNELS OF SIMPLE FORTRESS. See also Fig. 4.

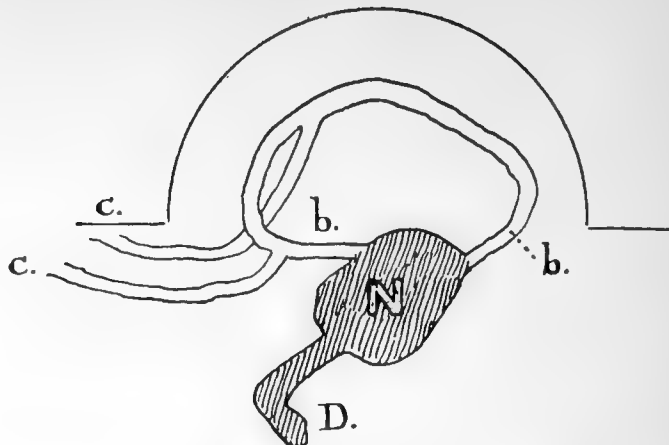


FIG. 4.—SECTION OF SIMPLE FORTRESS, plan of which is shown in Fig. 3.

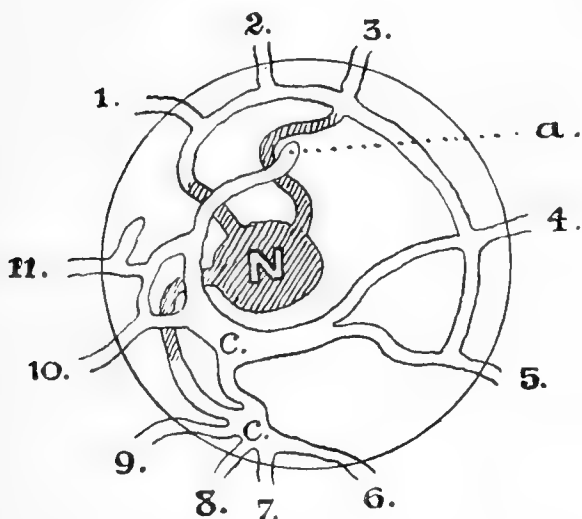


FIG. 5.—PLAN OF COMPLICATED FORTRESS, WITH ELEVEN EXITS.

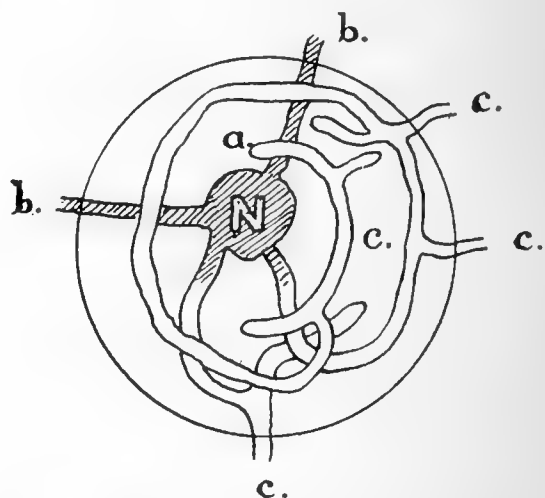


FIG. 6.—PLAN OF COMPLICATED FORTRESS, WITH SEVERAL BLIND TERMINALS. See also Fig. 12.

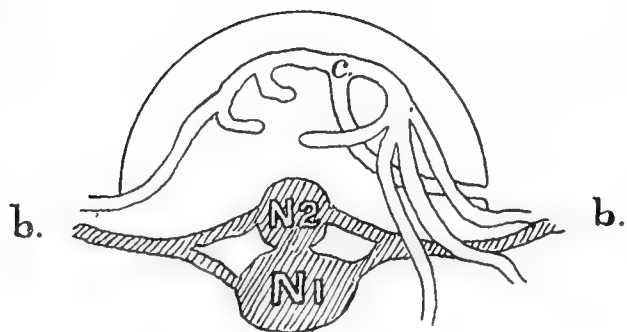


FIG. 7.—SECTION OF FORTRESS ON MARSHY GROUND, WITH OLD (N1) AND NEW (N2) NESTS. See also Fig. 8.

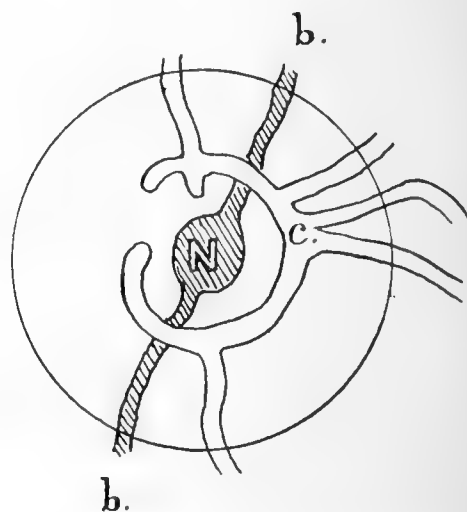


FIG. 8.—PLAN OF FORTRESS SHOWN IN FIG. 7.

the nest is often above the ground-level in the centre of a heap of earth which is thrown up from converging runs (Figs. 7, 8, and 9).¹ Now, the easiest way to dispose of the earth when the nest-cavity is being excavated is to push it upwards on to

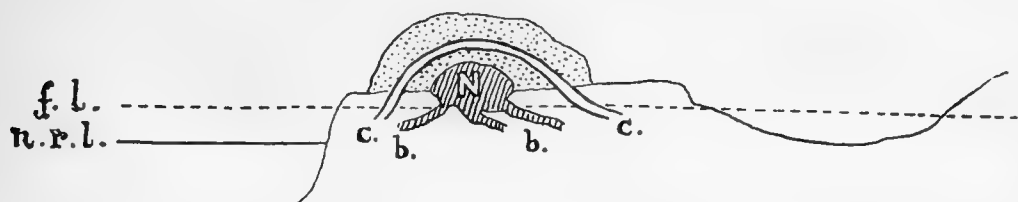


FIG. 9.—SECTION OF NEST ABOVE GROUND-LEVEL IN LAND LIABLE TO BE FLOODED.

the surface, and in order to do this a tunnel must be made. Fig. 10 shows the whole heap made entirely by this tunnel. Fig. 11 illustrates a low fortress on boggy ground, the whole heap being formed by a single tunnel (*a*) leading upwards from the nest. This nest had seven outlets just below the soil. There was no other tunnel or bolt-run."

"When this superincumbent earth has reached an inconvenient height another tunnel is made, sometimes from another part of the nest-cavity (Figs. 3, 4 *b*, *b*), but more often sideways from the first upward tunnel." Meanwhile the Mole is constantly making fresh runs from the fortress in various directions in search of food. As these fresh runs grow in length, the task of piling up the protective mound is lightened by the excavations of new tunnels from runs near the edge of the fortress, which usually lie above those leading from the nest-cavity.

The tunnels in the fortress serve two distinct purposes:—

(*a*) To eject earth from the nest-cavity and bolt-run.

¹ KEY TO LETTERING ON 18 DIAGRAMS OF MOLE EXCAVATIONS.

The same letters apply to all.

<i>a.</i>	= Apex of tunnels.	<i>l.c.g.</i>	= Lower circular gallery.
<i>b.</i>	= Bolt-runs, or tunnels made in excavating nest.	<i>u.c.g.</i>	= Upper circular gallery.
<i>c.</i>	= Tunnels made in forming protective heap, and their outlets.	<i>T.</i>	= Turf.
<i>D.</i>	= Downshaft.	<i>N.</i>	= Nest.
<i>f.e.</i>	= Flood exit.	<i>N1, N2, N3</i>	= First, second, and third nests.
<i>f.l.</i>	= Flood level.	<i>o.o.</i>	= Original outline of fortress.
<i>n.r.l.</i>	= Normal river level.	<i>o.t.</i>	= Original tunnel formed by heaping up the fortress.

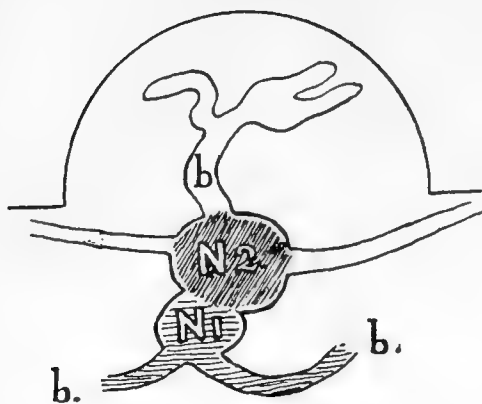


FIG. 10.—SECTION OF FORTRESS, with heap made entirely of earth excavated from nest, and pushed upwards through one tunnel. There are two bolt-runs.

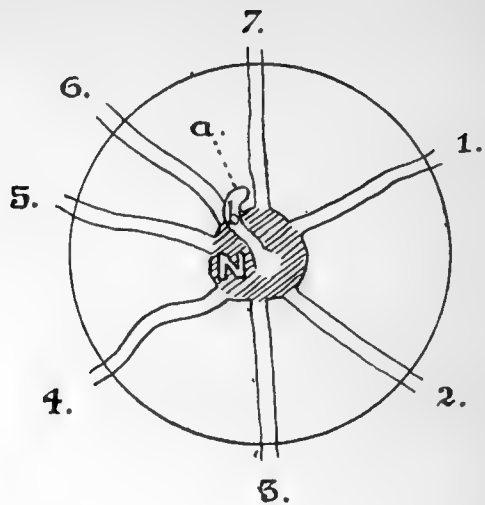


FIG. 11.—PLAN OF LOW-LYING FORTRESS ON BOGGY GROUND, the whole heap formed by a single tunnel (a) leading upwards from the nest. There are seven direct outlets from the nest.

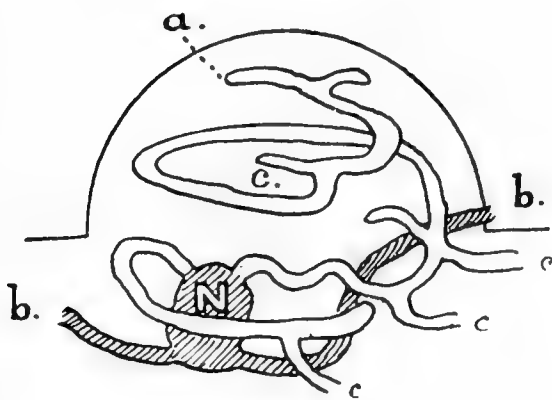


FIG. 12.—SECTION OF FORTRESS SHOWN IN FIG. 6, showing spiral gallery and blind terminals.

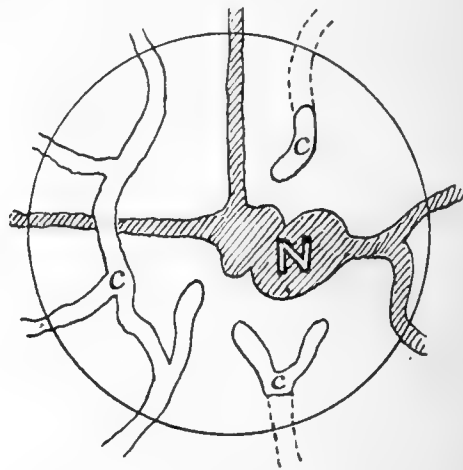


FIG. 13.—PLAN OF FORTRESS, showing portions of tunnels which subsequently fell in, and their probable course

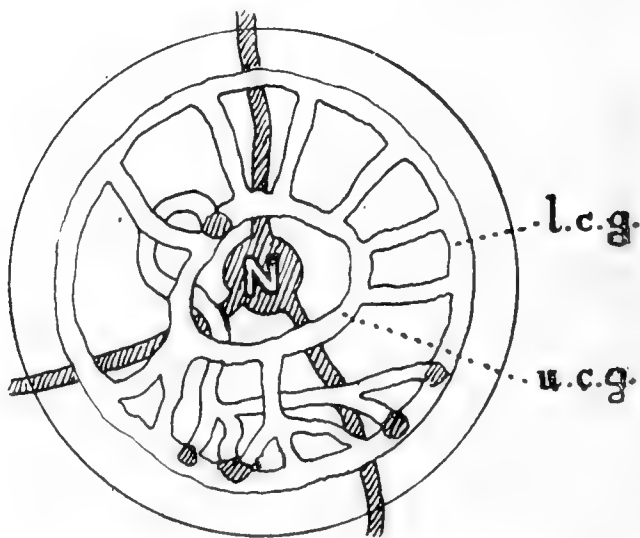


FIG. 14.—PLAN OF UNUSUAL FORTRESS WITH BOTH UPPER AND LOWER CIRCULAR GALLERIES.

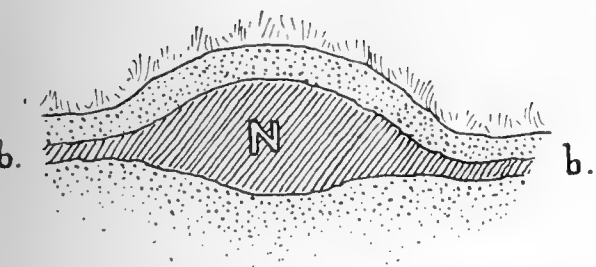


FIG. 15.—SECTION OF BREEDING NEST, lying just below slightly upraised and unbroken turf.

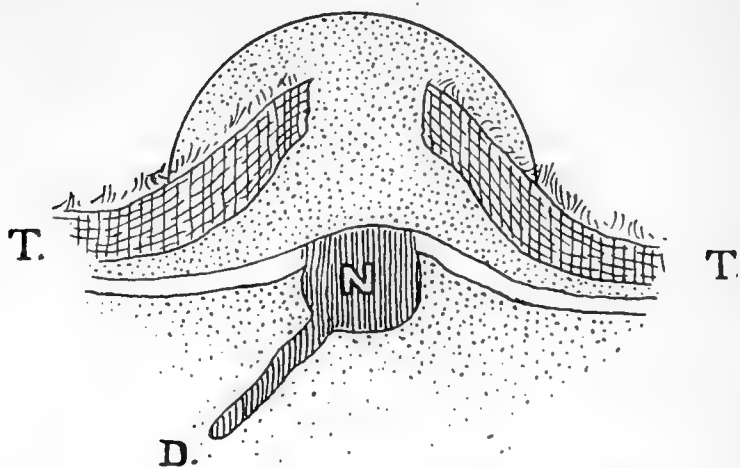


FIG. 16.—SECTION OF NEST UNDER MOUND IN BROKEN TURF IN PEATY LAND.

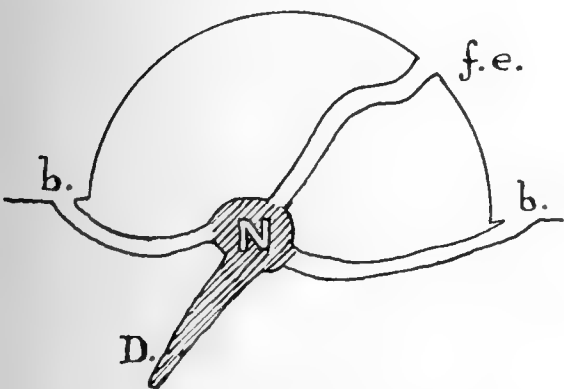


FIG. 17.—SECTION OF NEST IN MARSHY LAND. The down-shaft D, measuring eighteen inches in length from bottom of nest, was full of water when found ; *f.e.* was probably a flood exit.

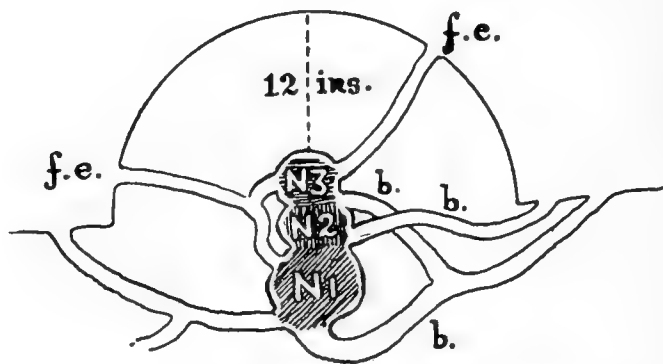


FIG. 18.—SECTION OF FORTRESS WITH THREE NESTS, the new one (*N3*) built on top of the others.

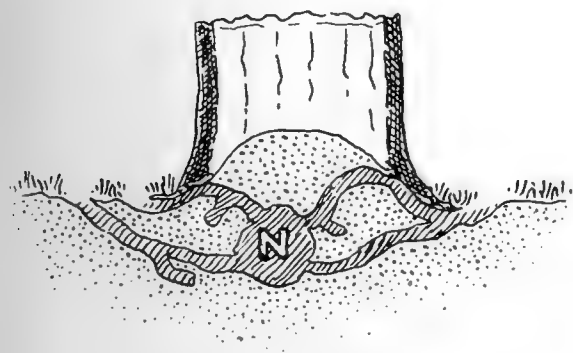


FIG. 19.—SECTION OF FORTRESS IN OLD TREE-TRUNK.

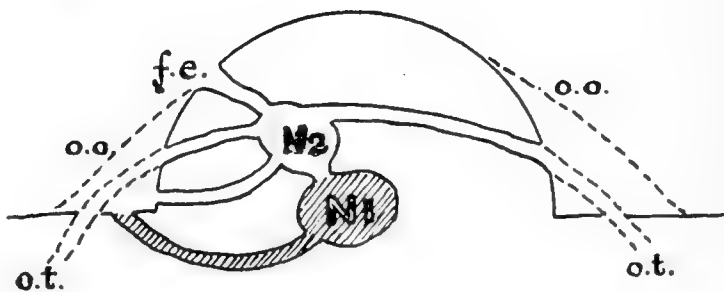


FIG. 20.—SECTION OF FORTRESS IN LOW BOGGY LAND.

These are generally in ascending spirals, and often terminate blindly (Fig. 12).

(b) Those not connected directly with the nest-cavity, but traversing the fortress from runs outside it. Through these earth has been carried to form a protective heap over the nest. Fig. 14 represents a rare case of the spiral tunnel assuming the stereotyped form of upper and lower "circular galleries," as represented by de Vaux and others.

The so-called "lower circular gallery" is formed, according to Mr Adams's explanation, when the many tunnels and up-shafts become connected at their bases during the heaving-up of turf. In peaty or marshy grounds large pieces of turf are often raised, and beneath such an upheaval Mr Adams has found a nest containing young.

The average fortress is about one foot in height and three feet in diameter, but Mr Adams has measured one fifteen inches in height and five feet in diameter. Mr Evans examined another, the diameter of which reached no less than eight and the height nearly two and a half feet.

The nest-cavity is roughly spherical, about the size of a large cottage loaf, and quite smooth from constant friction and use. The nest, which completely fills the nest-cavity, is a ball of grass, or leaves and moss,¹ or a mixture of all three. Mr Adams found a nest made entirely of dead beech leaves, others entirely of dead oak leaves. In a nest made of grass the finest and driest material is in the centre, the coarsest outside and mixed with damp earth. Usually, if taken out bodily, the nest must be unwound to find the centre, but on land where the grass is short it comes to pieces very easily. There is never a hole apparent, and not only is the nest always found closed when the young are within, but in all cases, even when old and long deserted. When dry grass is not obtainable fresh green grass is used, which soon withers and gets dry with the heat of the mole's body. The inside of the nest is warm to the touch when the animal has not long quitted it. Nests containing young, as well as those of the males found in their fortresses, are invariably infested with fleas and mites.

Despite le Court's contrary assertions, Mr Adams has in

¹ This paragraph, *fide* Adams and Evans.

HISTORY OF BRITISH BIRDS—*continued.*

histories of very many others, which were formerly little known, have been fully elucidated, while, speaking generally, an immense increase in our knowledge on such important subjects as Migration, Distribution, Habits, Nidification, Plumages, has accrued: And lastly, a new and important branch of study has been instituted—namely, the recognition of the various Racial Forms or Sub-species exhibited by certain birds in the British Islands, on the Continent, and elsewhere.

A great advance has also been made towards a more satisfactory system of classification of the Aves—always a difficult subject—and this necessitates departures from the older views.

To bring this Standard Work thoroughly abreast of the most recent knowledge in all these departments is the object of the present work.

It should be remarked that while it is not intended to go fully into Synonymy, yet, where changes of nomenclature have been necessary in order to conform with the Law of Priority—the only method by which complete uniformity in nomenclature can ultimately be attained—the names used in the Fourth Edition of Yarrell's "British Birds" and in Saunders' "Manual," and the Trinomial Names of the British Racial Forms, and of those occurring in Britain as visitors from the Continent, will be quoted, as will also the Original Name under which the species was described.

In requesting Mr Eagle Clarke to undertake the duties of Editorship, the Publishers desire to make it known that they are acting under the advice of the late Mr Howard Saunders, who placed all his collected notes for a New Edition at Mr Eagle Clarke's disposal for this purpose. That Mr Eagle Clarke is eminently fitted for the work is well-known to all who are interested in ornithological science. Through his investigations of the subject, and contributions to its literature, he has long been recognised as one of the foremost authorities on all that relates to British birds. He has studied our native birds in many portions of the British Islands, and has visited a number of bird-haunts in various parts of Europe in order to become acquainted in their Continental homes with the visitants that seek our shores.

On the important matter of the Migrations performed by British Birds, Mr Eagle Clarke's knowledge is unrivalled—a material fact, when it is called to mind how little has been said on this most important subject in any published History of British Birds.

A new and important feature of the New Work will be a Coloured Plate of each species. These will be reproduced in the best style from original drawings specially executed for the work by Miss Lilian Medland, F.Z.S., an accomplished and well-known bird artist.

GURNEY & JACKSON

PATERNOSTER ROW, LONDON, E.C.

In the Press, to be published shortly

STUDIES IN BIRD-MIGRATION

BY WILLIAM EAGLE CLARKE, F.R.S.E., F.L.S.

Member of the British Association Committee on the Migration of Birds as
Observed on the British and Irish Coasts, and Author of its Final
Reports, 1896-1903, etc.

With Numerous Illustrations and Maps

WITH the exception of the two initial chapters, this work is entirely original, being the result of the author's investigations and personal experiences. These have extended over many years, during which exceptional opportunities have been enjoyed for acquiring knowledge on Bird-migration generally, and its British aspects in particular.

In 1884 Mr Eagle Clarke was elected a member of the British Association Committee on the Migration of Birds as observed on the British Coasts; and on the completion of that great enquiry, he was requested by his colleagues to prepare the final reports on the results obtained—a difficult and arduous task, which he accomplished in 1903.

During the preparation of these reports (five in number), Mr Eagle Clarke became much impressed with the advantages which were likely to accrue from placing a trained ornithologist at a number of the most favourably situated observing-stations around our coasts. If this could be done, he believed that some of the difficulties which the phenomena presented might be solved, and our knowledge regarding the subject generally considerably advanced.

This conviction led him to undertake, by the special permission of the Elder Brethren of the Trinity House and the Commissioners of Northern Lighthouses, a series of personal investigations at various light-stations, each of which was selected for a special purpose. In all, Mr Eagle Clarke has resided no fewer than forty-two weeks in these isolated and remote observatories; the stations visited being the Eddystone Lighthouse, the Kentish Knock Lightship (33 miles off the Essex coast), the lighthouses on the Flannan Isles and Suleskerry (both lying far out in the Atlantic), and the lighthouse at Fair Isle (the "British Heligoland"). He also visited the Island of Ushant—an important station—and Alderney for similar purposes; and spent a month or more in the autumn of 1910 at St Kilda, for the purpose of carrying the investigations to the outmost fringe of the British area.

With these unrivalled experiences for its foundations, the book should not only prove a valuable contribution to the subject of Bird-Migration, but should occupy a place essentially its own in ornithological literature.

GURNEY & JACKSON

PATERNOSTER ROW, LONDON, E.C.

Oliver and Boyd, Printers, Edinburgh.

A HISTORY OF BRITISH MAMMALS

BY

GERALD E. H. BARRETT-HAMILTON

B.A. (CANTAB.), M.R.I.A., F.Z.S.

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1911

Part VIII. will be published on 15th September

In Preparation

A NEW AND REVISED EDITION OF
YARRELL, NEWTON, AND SAUNDERS'

HISTORY OF BRITISH BIRDS

EDITED BY

WILLIAM EAGLE CLARKE, F.R.S.E., F.L.S.

Keeper of the Natural History Department, The Royal Scottish Museum; Member of the
British Association Committee on the Migration of Birds as Observed on the British
and Irish Coasts; Corresponding Fellow of the American Ornithologists' Union;
Correspondirender Mitglied des Ornithologischen Vereins in Wien;
Membre Honoraire du Bureau Central Ornithologique Hongrois;
Member of the British Ornithologists' Union, etc.

ILLUSTRATED BY ORIGINAL COLOURED PLATES OF EACH SPECIES
SPECIALLY EXECUTED BY

MISS LILIAN MEDLAND

THE publication of Yarrell's "History of British Birds" was commenced in 1837 and completed in 1843. Its outstanding merits were at once recognised, and a Second Edition was called for in 1845, followed by a third in 1856.

From the issue of the Original Edition down to the present day, Yarrell's "History of British Birds" has generally and deservedly been regarded as the standard authority on British ornithology.

In the year 1871 a Fourth Edition was begun, under the masterly editorship of Professor Newton—the greatest British ornithologist of all time. Unfortunately Professor Newton's official engagements at the University of Cambridge only allowed him to complete the first two volumes; and in 1882 Mr Howard Saunders was selected to edit the remaining volumes, a task which he successfully accomplished to the entire satisfaction of ornithologists in 1885.

The many excellences of this last edition advanced the work more than ever in the public and in scientific favour. To its stimulating influence is to be mainly attributed the marvellous and unprecedented activity which has resulted in those extraordinary advances made in all branches of British ornithology during recent years—advances which have rendered it essential that a new work based upon this classical and comprehensive foundation should be issued.

During the period alluded to, a considerable number of new and interesting species have been added to our avifauna. The

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TALPIDÆ—

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ERINACEIDÆ (True Hedgehogs)—

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The English local names have been revised in part by Mr W. W. Skeat, M.A. (assisted by Professor W. W. Skeat), and in part by Mr C. M. Drennan, M.A. Lond., late Scholar Emm. Coll. Camb.; the Celtic and Gaelic names by Dr E. S. Quiggin, M.A., Ph.D., Fellow and Lecturer in Modern Languages and Celtic of Gonville and Caius College, Cambridge; while a list of Scottish Gaelic names have been supplied by Mr C. H. Alston. Valuable assistance has been rendered by Mr M. C. A. Hinton regarding extinct Mammals.

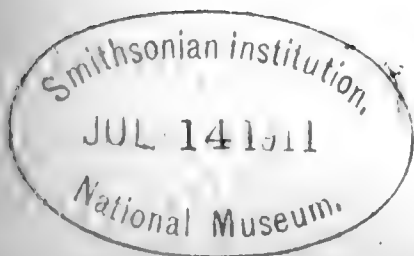
ILLUSTRATIONS

FULL-PAGE (*Coloured and Black and White*).

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- The Mole.—Head and Fore Limbs—(1) Ventral; and (2) Side View. (*Magnified*.)
- The Mole.—(1) Left Hand; (2) Foot; and (3) Dorsal View of Tail. (*Magnified 1½ times*.)
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- Mole heaving up Loose Earth. (*Diagrammatic; after Adams*.)
- Skull of Hedgehog, *Erinaceus europæus*—(a) from above; (b) from below. (*Drawn by G. Dollman*.)
- Side View of Teeth of *Erinaceus europæus*. (*Diagrammatic and magnified 1½ times*.)



only one instance found a nest in which the component materials were mixed with fur taken from the Mole's own body.¹ He believes that the presence of the fur was accidental, and due to natural moulting of the coat. Sometimes the fur of other animals, or the feathers of birds, especially rooks and fowls, find their way² into the nest, but it is difficult to decide whether fur or feathers are used knowingly or merely by chance.³

"Nearly every fortress has a bolt-run, by which the mole can escape when surprised in the nest. This run leads downwards from the bottom of the nest, and then turns upward and out of the fortress by a tunnel of its own, and is very rarely connected with any of the other numerous exits of the fortress. The only fortresses that I have seen without the bolt-run have been on marshy land, where such a tunnel would have led to water."⁴ (See Figs. 9 and 15.)

"Occasionally one comes upon a downshaft, leading directly from the nest downwards almost perpendicularly for sometimes nearly three feet. The use of these downshafts is puzzling. Where the land is low-lying and the soil moist they may be intended to drain the nest, but this is inconceivable in the Bunter sandstone on high ground above the level of the highest floods, where I have found them on more than one occasion. It has been stated that they are deliberately sunk as wells to supply the mole with water, a notion which, I imagine, has arisen from a flooded fortress having been explored. Figs. 4, 16, and 17 illustrate such fortresses, which came under my notice, but it is ridiculous to suppose that the mole foresees the possible rise of water from below, and equally ridiculous to suppose that he digs the well through the water when it has risen."

Mr Adams makes the suggestion that these downshafts are abortive bolt-runs, which have been abandoned when it was found that the right point to turn upwards had been missed, a suggestion which he thinks gains probability from the fact that when the downshafts occur the bolt-run is absent.

¹ This nest was forwarded for my inspection, but, unfortunately, never reached me.

² As reported by W. H. St Quintin, *Field*, 31st March 1883, 431, a nest contained, besides moss and dried grass, two handfuls of fur and the mutilated body of a recently killed mouse (*Microtus agrestis*).

³ For a description of the actions of a mole when collecting leaves for its nest, see note on p. 43 *infra*.

⁴ Adams.

It appears that a nest is never resorted to in a second year, but a fresh one is made each year close to the same spot. Thus two or three nests, only one of which is as a rule fresh and inhabited, are frequently found in close conjunction. The new nests are often built on top of the others, and are constructed of fresh material brought in from outside (Figs. 7, 10, 18, 20). Two inhabited nests are very rarely encountered in contiguity, and the most conspicuous instances known to Mr Adams have been those of breeding females.

In its choice of a site for a fortress the Mole is influenced by the available supplies of food and water, but probably all other incidents of its surroundings are accidental. In the vast majority of cases the fortress is placed in an open field, but occasionally in a coppice, a hedgebank with an adjoining ditch, a hollow amongst old roots, or under a tree—in the latter case probably without definite choice or intention.

The "high-road," although a very important part of the domain of the male, does not differ essentially in its construction from the other routes and excavations, but only in being more frequently used, so that its walls are beaten until they become smooth and compact. It extends from the fortress to a distance in a nearly direct line, forming in fact the main route of communication between the fortress and the different parts of the encampment; and the alleys which lead to the hunting-grounds, or quarries, open into it on each side. All the runs, whether ordinary or high-roads, are large enough to allow two individuals to easily pass each other. It seems likely that they must sometimes do so, although the popular belief is that moles never intrude upon each other's company, and that, should two of them meet, one must retreat, or a battle to the death ensues. Probably, however, like another burrowing mammal, the Pocket Gopher¹ of North America, the Mole also has the power of running backwards tail foremost in its galleries, but only two writers—J. L. Knapp² and Captain Mayne Reid—have mentioned this possibility. It is also very supple, and can easily turn right round in any part of its tunnels. The high-road is probably formed at a

¹ *Geomys lutescens*, C. Hart Merriam, *North American Fauna*, No. 8, 16, 31st Jan. 1895. In this animal the short, nearly naked tail has been developed as an organ of touch.

² *Journal of a Naturalist*, ed. 2, 150, 1829.



PYGMY OR LESSER SHREWS.

greater or less depth from the surface, according to the nature of the soil, its humidity and hardness. Thus, where the soil is soft, it will be found at a depth of about four or five inches; but where the ground is hard, as under a road or beneath a stream, the earth is left not less than a foot or a foot and a half deep above it.

"It is truly marvellous," writes Mr Adams, "how runs are made at all in such difficult ground as Bunter sandstone, where the spade will hardly penetrate, yet the Mole will make his accustomed runs, and turn out among the heaps of sand stones weighing over 4 oz., which is the maximum weight of a mole. Worms in this ground must be comparatively scarce, and, one would think, mostly found at the roots of the grass at the

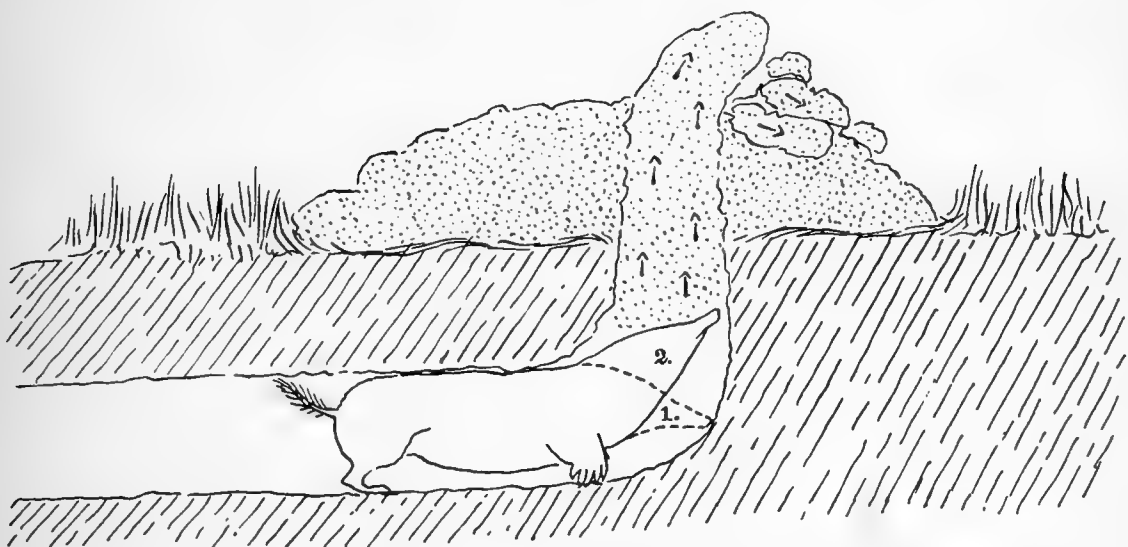


FIG. 21.—MOLE HEAVING UP LOOSE EARTH (diagrammatic; after Adams).

surface, yet in this formation the runs are always very deep, often nearly a foot below the surface, and very wide."¹

It is not quite clear how the soil is pushed out of the ground in making a heap. Mr F. R. Rodd² described the heap as rising very gradually with a motion from the centre exactly as flour does in a pan with yeast, a puzzling process which led him to suppose that the only way the work can be done is either by the animal standing almost on its head, or else throwing the earth up with its hands. So far, neither method has

¹ R. Kearton's *Wild Life at Home*, 1899, 128, contains some remarkable statements as to the great strength of the animal.

² *Zoologist*, 1872, 3182.

been confirmed by observation, and Mr Adams, following Capt. Mayne Reid, doubts the possibility of the earth being kicked out by the hind legs. After watching captive specimens, he believes that the earth is thrown out by the head, which a digging mole is constantly raising and lowering.¹

The swiftness with which a mole will traverse its domain by means of the principal road is illustrated by most writers by reference to the famous, but doubtless exaggerated, story of the "trotting horse," a test instituted by le Court. Cold truth, however, reduces the rate of progress, often seen at best speed above ground by Mr Adams, to a pace never faster than a slow walk, or about two and a half miles an hour. Even if this, as is probable, can be exceeded in the tunnels, especially under the excitement of a stimulus like le Court's *cri effroyable*, there would still remain much scope for imagination before the animal could be affirmed to rival a horse at full trot.

The alleys or galleries are opened from the sides of the high-road in all directions and without definite plan. As already stated, they differ from it only in the fact that they are used less frequently. Mr Adams believes that in forming its runs, or excavating its quarries, the Mole at first simply digs its way through the ground, paying no attention to the loose soil. After a time it retraces its steps, and when returning pushes the loosened earth before it till the accumulation blocks. It then makes its way to the surface through the solid earth, opening a new shaft, over which a hillock is gradually formed by the successive portions of earth which are brought from the scene of its mining operations.

But the labours of the animal are not confined to the deep excavations already mentioned. In summer, when land newly sown is consequently light and yielding, and moderate rain

¹ The *modus operandi* of the Pocket Gopher, as observed by Merriam (*op. cit. supra*) from a captive specimen, is worth noting here. The animal differs, however, from the Mole in being a rodent with large incisors and fore feet of quite distinct type. When constructing a tunnel it uses its incisors as a pick, its fore feet both in digging and in pressing the earth back under the body, and its hind feet for moving the earth still farther backward. When a sufficient quantity of earth has accumulated behind it, it "turns in the burrow and by bringing the wrists together under the chin, with the palms of the hands held vertically, forces himself along by the hind feet, pushing the earth out in front." When an opening is reached the earth is discharged, but exactly how is not stated.



(1)



(2)

THE MOLE.

HEAD AND FORE LIMBS—(1) Ventral and (2) Side View (magnified).

has brought the earthworms to the surface, it follows them, and pursues its chase along the superficial layer of the soil, digging a shallow continuous trench, in which work it advances with great rapidity. This is done by merely forcing its way through the light soil, and thus lifting it up; at such times the mole-catcher steals softly upon it and throws it out of the ground with his paddle. But great quickness is necessary in doing this, for a mole will bury itself again so rapidly as often to escape, even when fairly thrown on to the surface. In these shallow surface-runs the soil falls away on each side, leaving the creature's back exposed to view. There is no evidence to connect such runs with the gravid female or with the breeding of the animals; they owe their existence rather to the position of worms and grubs and the wetness of the soil. Mr Evans informs me that he has seen and captured a mole when burrowing amongst dead beech leaves, a favourite habitat for certain kinds of worms.

In summer the Mole works hard and continuously, and its tell-tale upheaving of soil may be seen at every hour of the day.¹ Yet its work is often less conspicuous than in winter, probably because worms are more easily caught and the need of new tunnels to secure them is, therefore, not pressing. In fact, the multitudes of worms on the surface in their pairing season are alone worth hunting, so that the runs are often deserted and the easier pursuit taken up above ground. The animal's thirst, too, must be satisfied when water is scarce. This is the time when its diet is most varied, slugs and snails being frequently captured, with an occasional vertebrate; but the tables are sometimes turned and the Mole itself killed and eaten, especially when it neglects to get below ground before daybreak.

Occasionally a mole's tracks are seen on snow. They resemble the impression that might be made by a rope two and a half inches in diameter dragged along the surface, with the marks made by the hind feet and the claws of the fore feet sometimes visible, to indicate the direction. Such wanderings may be due to movements of worms, in consequence of the hardness of the soil, but certainly not directly to the state of the ground, since Mr Evans has

¹ E. D. Cuming, *Arcadian Calendar*, 17.

watched the heaps being thrown up during times of severe frost. Sometimes a mole passes along the surface of the ground beneath the snow, "making a sort of gutter of a run."¹

The Mole is a capable, if not a willing,² swimmer, and it has many times been observed in water, either escaping from a flood, changing its hunting-ground, or even occasionally enjoying the luxury of a bath.³ Sometimes it ventures to face a river or lake,⁴ even when of considerable extent; but examples which have been encountered swimming in the middle of a loch such as Morar⁵ in Inverness-shire—traversing an expanse of water a mile and a half wide—must surely have been out of their depth both geographically and hydrographically, or they would never have attempted such a feat. Mr Adams describes a captive as swimming with the entire head and back to within half an inch from the tail high out of the water, and the end of the tail protruding above the surface. The movements of the limbs are very rapid, they work downwards and backwards after the manner of a dog, and the animal attains a fair pace in proportion to its size. Like other voracious feeders, it requires to drink frequently, but the belief that its runs are always connected with the nearest ditch or pond for that purpose, is only in part founded on fact, so that it must obtain sufficient water with its food, or, perhaps, by night from the dewy herbage.

There can be no doubt that the Mole feeds almost exclusively on invertebrates, and that the principal objects of its search are earthworms. It will consume, however, practically anything living that may come in its way, and mice, birds, lizards, frogs, or snails, if placed within its reach, become speedy victims to its voracity. But it is absurd to think that an animal of

¹ Owen Jones, *The Scout*, 25th February 1911, 488.

² A. H. Cocks found one with which he experimented only a very poor performer.

³ Bell, ed. 2, 130-131; Thomas Southwell, *Zoologist*, 1888, 22.

⁴ E. Parfitt, *Zoologist*, 1860, 7169; S. D. Hine, *Field*, 24th June, 1876, 729; George Hales, *Journ. cit.*, 4th September 1880, 360; James Carter, *Journ. cit.*, 16th April 1892, 545; Riley Fortune, *Journ. cit.*, 23rd April 1892, 585; G. Hill and B. F. Edyvean, *Journ. cit.*, 30th April 1892, 625; W. Soundy, *Journ. cit.*, 14th May 1892, 704; Max Peacock, *Naturalist*, 1901, 44; W. A. Dutt, *The Norfolk Broads*, 127 (see *Zoologist*, 16th May 1904, 186-187); G. C. Williams, *Field*, 29th July 1905, 200, and many other references.

⁵ A. P. Morres, *Zoologist*, 1877, 440-441; G. Hill, *Field*, 30th April 1892, 625.

such structure could make an habitual practice of pursuing vertebrate animals.

Individuals must vary considerably in their habits and practices, since the Rev. A. Woodruffe-Peacock¹ informed Mr Adams that he had known moles to seize some young pheasants and a young blackbird by the feet in the shallow runs, and his brother found a hooded crow picked clean, the tracks on frozen snow clearly identifying the diner. Whether, as suggested by Mr C. Witchell,² it is an enemy to snakes or vipers in their winter sleep is, however, quite uncertain. Alston³ offered a small toad to a captive mole, but it was rejected after examination; but, as a general rule, toads, as regards edibility, occupy a class entirely by themselves. To all other creatures, not excepting the weaker of its own species, the Mole exhibits a savage and unreasoning ferocity, and if two be placed together in a box without a plentiful supply of food, the weaker will soon fall a prey to the stronger. No bulldog keeps a firmer hold of the object of its attack than the Mole.

The Mole has been accused of feloniously burrowing under the nests of pheasants and partridges, "not by accidentally coming across them in its working, but working up to them to get at them."⁴ It is probable, however, that the letting down of the eggs is in reality accidental, and that the sole attraction in such cases is the moist soil and plentiful supply of insects.

This is the view of Mr Owen Jones, who has had great experience as a gamekeeper, and who writes me that, although he has had any number of nests upset and the eggs let down into the tunnelling, he has never seen any evidence to show that moles directly meddle with them. He once took a clutch of uninjured pheasant's eggs⁵ from a run underlying the nest;

¹ A similar instance is narrated in the *Field* of 16th February 1901, 226, by C. A. Hamond.

² *Zoologist*, 1883, 293-4.

³ *Journ. cit.*, 1865, 9707.

⁴ C. E. Wright, in Adams; see also W. S. Medlicott, *Field*, 29th April 1905, 726; and for similar treatment of a partridge's nest, F. Dent, *Journ. cit.*, 17th August 1901, 312. Dogs are said not to be able to scent sitting birds, but the odour of the nest may be much more perceptible from beneath than from above, and eggs appear to suddenly acquire a strong odour just before the end of incubation (see below, under Hedgehog, pp. 63 and 67).

⁵ *Ten Years of Gamekeeping*.

and the excavations of a mole beneath her caused a woodcock to forsake a clutch of eggs which came under Mr Evans's observation, although they were only moved slightly.

In spite of the obviously worm-eating character of the animal, many writers, amongst them le Court himself, have stated that vegetable substances may form no inconsiderable part of its diet. The roots of the artichoke, together with turnips, potatoes, carrots, and the young fibres of trees, have all been mentioned in this connection. Such statements, however, have always been received guardedly, if not incredulously, by naturalists, who have pointed to the extreme gluttony and raging frenzy of a hungry mole as exhibiting none of the characters of a vegetarian or even of a mixed feeder, and have concluded that the vegetable matter discovered in its stomach must have found its way there accidentally during its digging operations. However that may be, the suggestion that it may be partly herbivorous, although improbable, is not absolutely untenable, since we know that other insectivores are certainly in part vegetable feeders.¹

Like shrews, adult moles are very impatient of starvation, and die very soon if left without food. Mr Adams states that on one occasion he caught one, vigorous and quite unhurt, and fed him at intervals during the day with about a third of a pint of worms. Having placed a similar quantity in his den (a packing-case with earth at the bottom), he left him for the night. "In the morning I found him very feeble, thin and cold. I took him up in my hand and put his nose to some water, which he seemed to enjoy, but he was too feeble to tackle a worm, and presently, after a gentle convulsion, he died in my hand. I found on dissecting him that the stomach was absolutely empty, in spite of the fact that he had eaten

¹ This is stated to be true of the Japanese Mole-Shrew (*Urotrichus talpoides* of Temminck; see Oldfield Thomas, *Proc. Zool. Soc.* (London), 28th November 1905, 341-342), and of the American short-tailed shrews of the genus *Blarina* (see C. Hart Merriam, *Vertebrates of the Adirondack Region*, ii., 71, 1884; also E. Thompson Seton, ii., 1126, etc.); the latter will eat beech-mast, oats, and corn meal. North American agriculturists have recently become alive to the fact that the animal which does duty with them for the European Mole (*Scalops aquaticus*) may sometimes consume such quantities of corn as to cause considerable damage to farmers. (See R. L., *Field*, 11th February 1911, 281, where references to some American publications are given, but I have been unable to find the originals.)

every worm left for him. Baby moles, on the contrary, live a surprisingly long time without food ;¹ in fact, their capabilities of resisting starvation vary inversely as their size, the irregularity being perhaps accounted for by some having fasted longer than others before being taken from the nest."

Although it has been stated above that the Mole makes no provision for the winter, it must not be forgotten that many writers allude to stores of injured or paralysed worms which are supposed to have been collected for future use. The belief is said to be widespread amongst mole-catchers, but, so far as I can gather, appears to have been first printed by Edward Jesse.² An anonymous writer³ on the same subject has been often quoted. This writer declared that when in company with a man employed to poison moles, which he did through the medium of earthworms, he observed him obtaining his bait from cavities in the largest molehills of a marsh in Norfolk. The cavities were round and "beaten hard by the mole so as to prevent the escape of the worms." This story was received with incredulity by Edward Newman,⁴ and doubted by the late Thomas Southwell.⁵ Like many other statements advanced by untrained writers, it would appear to be the result of imagination rather than an invention. Although no trained zoologist has had the good fortune to examine such an undoubted store of worms,⁶ many have found smaller "knots" or accumulations of them. Southwell believed that such worms are merely individuals which, from one cause or another, have found their way into disused runs from which they have been too feeble to escape. What has been pointed out to him as an injury inflicted in order to disable the worms, has invariably proved to be the series of thickened segments known as the clitellum. The flaccid, unhealthy appearance of such worms, as noticed by Southwell, is independently corroborated by Mr Adams, who sees nothing unusual in the matter, since he has frequently, in digging his garden, come across similar

¹ See also H. Laver.

² *Gleanings in Natural History*, 6th ed., 136, 1845.

³ *Field*, 13th March 1875, 267.

⁴ *Zoologist*, 1875, 4493.

⁵ *Journ. cit.*, 1888, 21.

⁶ The nearest approach is the statement of a farmer to Adams, that he found "three spadefuls" of dead worms heaped up in the nest-cavity of a fortress.

knots or bunches of pallid, sickly looking, semi-torpid worms. In early spring he has often found a similar knot of worms, three or four in number, embedded in a semi-torpid state in the solid earth of fortresses, where he believes they had congregated of their own free will. He has never met with knots of worms in the tunnels, and concludes that their presence in a fortress is explained by their having fallen in and been unable to get out again.¹ But, although there is thus no trustworthy evidence supporting the theory that moles store up worms, it is interesting to find that they possess the instinct to do so. Alston's captive often buried its food, and Mr Adams relates that on one occasion when he had fed one until it could eat no more, it took a worm, bit it with quick bites along its whole length, crammed it into the earth, left it, and turned about to find another.² On receiving one, a large lobworm, it treated it in precisely the same manner, thrusting it into the same hole and straightway covering it up with earth scraped over it with its fore paws. On two other occasions this mole was observed to bury worms, and once a dead mouse, in the same way. On the whole, it seems unlikely, although the Mole may sometimes disable and bury surplus worms, that its victims should when thus treated remain alive for a sufficient length of time to be of use as a reserve of food.

There are many errors in the ordinary accounts of the breeding habits of the Mole, the most serious being the belief that males are much more numerous than females. The mistake arose from the fact that, as pointed out by Geoffroy, it requires expert knowledge to distinguish the sexes externally. Mr Adams finds that males and females are about equal in numbers, which fact obviates the necessity for the supposed bloody battles between the superfluous suitors as described in text-books.³ There is only one short rutting season. This is, in Staffordshire, practically confined to the latter part of March, April, and perhaps occasionally the beginning of May. Mr Adams's

¹ This is also the explanation given in an interesting paragraph on this subject in W. A. Dutt's *Wild Life in East Anglia*, 183, 1906.

² Captive shrews act in a similar manner (Cocks, *in lit.*).

³ A fight between two males took place, according to Mayne Reid (*op. cit. supra*, p. 19), above ground on a 21st December.

earliest personal record for a foetal litter is 13th April, and he has notes of young found in the nest from 24th April (on the authority of a mole-catcher), 4th May (about seven days old, his earliest personal record) to 25th June (his latest record). The latter were almost ready to leave the nest, and were, therefore, at least three weeks old.

Practically all the young, therefore, are born within the period commencing about 24th April and ending about 4th June.

The fact that the runs made by the two sexes are distinguishable, shows that they usually live apart ; but during the breeding season the males leave their own long straight runs, and are found in the winding tunnels which are the work of the female. Here, no doubt, pairing takes place ; as it may, possibly, also above ground, as once observed by a keeper who informed Mr Adams.

Very similar results have been independently obtained by Mr Evans, working in the Edinburgh district, and by Mr Cocks in South Buckinghamshire. Mr Evans found embryos from the 7th April onwards, and, on the 24th May, young which he judged to be about a week old. Mr Cocks reports embryos from 14th April to 20th May. On the 21st May two young ones were captured, of approximately three-quarters full size, so that they were probably born about the 1st of May ; and in 1877 two litters (of four and three) were found on the Berkshire side of the Thames at Bisham on 28th April. Mr Cocks remarks that, whereas the embryos examined in April showed only a very little variation in size, some found on 14th May were younger than those of a month earlier, and others found on 20th May only equalled the size of a foetal litter found on 18th April, or over a month previously.

Calculating that the period of gestation is four weeks, or rather more, Mr Adams thinks that "the female would not have time to breed twice within the period mentioned during which young are found, even if she were in condition to do so, which she is not. Moreover, these limits are not those of the same year or locality, so they may be fairly curtailed, and a month of courtship may be presumed to be the limit of the Mole's capacity." On the other hand, there may be a few excep-

tional cases, probably of young animals, breeding later, which might account for Mr F. G. Aflalo's "young in August."

The female constructs a quite separate¹ fortress and nest in which to bring forth her young. This is usually, but not always, of simpler construction than the fortress of the male, and seldom possesses a bolt-run. Mr Adams, however, has sent me a description of one—so far unique in his experience—in which there were two bolt-runs. He has also figured a breeding-fortress in which there were two inhabited nests, each with a bolt-run. Although de Vaux says without hesitation that moles live in pairs in the habitation of the male until the female leaves her spouse to prepare her nursery, Mr Adams is by no means convinced that this is the case. He has "never been able to trap a female in or close to a male's fortress, and if we are to judge from the analogy of the rabbit (which makes a separate nursery, presumably to protect her young from the voracious father or fathers), we may suppose the Mole to be polyandrous."

"As far as my information goes," writes Mr Adams, "no mammal prepares a nursery till well advanced in pregnancy; if this holds good with regard to the Mole, six weeks is nearer the actual period of gestation than one month, as some fortresses from which I have taken the young have been made about one month previously."²

The average number of young in a litter, according to Mr Adams's experience, works out at rather more than $3\frac{1}{2}$.³ To find two is very rare, and he has only in a single instance met with a solitary young one. The greatest number is six, which is also very occasional. He has heard of seven. The following table gives his personal records:—

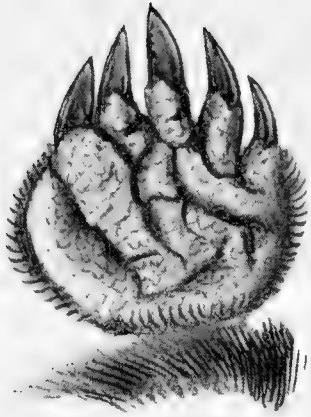
Number of litters containing one .	1	Number of litters containing four .	31
" " " two .	4	" " " five .	4
" " " three .	20	" " " six .	1

¹ See Mrs Rose Haig Thomas, *Field*, 3rd October 1903, 600.

² Adams has since sent me a note of a nursery made only four days before it was occupied by young.

³ Twenty-one pregnant Scottish females gave Evans an average of 3.86 embryos, and Cocks found an average of (exactly) 4 embryos in nine females, or, including the seven young in two litters mentioned on the previous page, an average of 3.9.





(1)



(2)



(3)

THE MOLE.

(1) LEFT HAND AND (2) FOOT, AND (3) DORSAL VIEW OF TAIL
(magnified $1\frac{1}{2}$ times).

The young, which are hairless at birth, grow so rapidly as to double their length within the first ten days of their life. At about the ninth day the advent of the fur is heralded by a change of hue on the back from pink to dull lead colour. On about the fourteenth day the fur begins to make its appearance, and by the twenty-second it is of normal length and colour. The ears open on about the seventeenth day and the eyes on about the twenty-second day, soon after which the young are nearly as big as their parents. They probably leave the nest in or after the fourth week. Mr Adams's interesting observations on this point, which are printed above in tabular form on p. 12, were interrupted by the fact that the nests in which he measured young moles were all eventually found empty at various dates before the conclusion of his investigations. The circumstances suggested removal of the young by their mothers.

The ancients in general appear to have had but vague notions respecting the habits and structure of animals; from this charge Aristotle is in an astonishing degree exempt. It has, however, been adduced as an instance of erroneous and superficial observation, that he held the Mole to be absolutely blind. In this, however, as has appeared above, he certainly wrote quite correctly of the species found in southern Europe; but Shakespeare¹ was on more treacherous ground when he laid such stress on this aspect of the animal in describing "The blind Mole" which "casts copp'd hills towards heaven." Numberless minor superstitions are current concerning the animal: it cannot live where Irish earth has been spread; in Staffordshire it possesses only one drop of blood;² in Surrey it has but one ear; in Lincolnshire it leaves the ground only once a year to take a little fresh air by daylight;³ in Scotland its burrowing near a house betokens the speedy departure, or even death, of the inhabitants.⁴ In many places people believe that moles wandering above the earth are "moonstruck";⁵ while it is on record that a mole's heart swallowed warm and palpitating confers skill in divination, and that a sprinkling of the blood makes a crazy person sane.⁶ It

¹ *Pericles*, i., 1.

² Adams.

³ *Fide* C. B. Moffat (*in lit.*).

⁴ A. R. Forbes, *Gaelic Names of Beasts, etc.*, 1905, 188.

⁵ J. G. Millais.

⁶ Cuming, *Arcadian Calendar*, 182.

will be appropriate to mention here the picturesque prophecy of the Scottish soothsayers,¹ that when the moudiewarp has overrun Argyllshire to the Mull of Kintyre, it will drive all the Campbells, the great landowners of the district, from their estates.

The Mole has always been the object of the most determined persecution on the part of farmers and gardeners, who accuse it of causing injuries, more or less serious, to the various products of the soil. The truth of each accusation must, as Mr Adams observes, vary with the circumstances, but it cannot be denied that a heavy list of indictments can be registered against it. Even after excluding the assertion that it causes inundations, which can be but seldom; and the somewhat far-fetched suggestion that it encourages mice by leaving them its deserted fortresses; there remains the destruction of the crops by disturbance, exposure, and severance of their roots, or by their being dug up or scattered and carried off bodily to the fortress to form part of the nest. No part of field, garden, or plantation is exempt from these ravages, and de Vaux estimated the loss to the spring corn in France at not less than one-eighth of the whole crop. Sometimes a field is so extensively mined that the area covered by molehills appears to exceed that of the vegetation, and their presence, even in small quantities, is a great obstruction to mowing. Against accusations such as these the mere condoning of the damage, the suggestion that the contents of molehills spread on the fields afford excellent topdressing, or the assertion that the injuries are counter-balanced by the benefits rendered through aeration of the soil and the destruction of noxious insects, are of little avail. The fact of the devastations cannot be denied, even if the degree and extent of them be incorrectly reported, and few farmers would like to see moles on their land for the sake of any problematical advantages accruing from their presence.

The history of the efforts made by farmers to cope with the damage done is probably as old as that of tillage or haymaking. Fanciful hints as to the destruction of the animals were compiled in Latin by Palladius,² probably about the fourth century, and

¹ Alston, *Zoologist*, 1867, 882; according to Boyd Watt (1905), the Mole is said to have spread to Campbeltown only recently, and not yet to be known in Southend.

² *Op. cit. supra*, p. 6.

Mr J. E. Harting has seen an entry of the wages paid to men who spread molehills in England in 1480.¹ On the other hand, the late Robert Service stated² that mole-catching as a regular trade did not begin in South Scotland until 1797. A minute investigation of the history of mole-catching is here impossible, but reference may be made to Macpherson's work for an account of it in Lakeland, where the practice was certainly in vogue in 1612. The animal was hunted down either privately, or in some cases by the residents of a locality clubbing together. The mole-catcher was often employed by the parish, so that the amounts which he received appear in the churchwardens' accounts of most parishes for the seventeenth century. Generally a penny a head was paid, but at Harrold (Bedfordshire) the mole-catcher's remuneration was £2 a year.³ It appears that a mole-catcher was still paid by the Cambridgeshire parish of Dry Drayton in 1880,⁴ but Mr Adams remarks, not without reason, that the whole race would have long since vanished, with the objects of their pursuit, had they directed their attention to the destruction of the young in their nests instead of confining themselves to trapping the adults.

So strong is opinion against the Mole, that the humble profession of mole-catcher has become celebrated ; and the followers of this calling are said to earn a considerable income in a season at a trifling sum for each animal captured. One trapper named Jackson, with whom Bell was in communication, declared that he had destroyed from 40,000 to 50,000 moles in thirty-five years. Jonathan Couch informed Bell of another who in Cornwall took no less than 1200 of these animals in six winter months ; while, according to Dr Laver, the two brothers Watchem (or Watsham) have secured no less than 1500 fresh skins in a single season at Colchester. But all others must yield to le Court, who in the short space of five months accounted for no less than 6000 moles within a comparatively small district ; and two of his pupils, during the month that they were under his instructions, killed 971.

¹ *Zoologist*, 1887, 445.

² *Ann. Scott. Nat. Hist.*, 1896, 202.

³ J. Steele Elliott, *Zoologist*, 1906, 254.

⁴ Rev. F. A. Walker, D.D., *Journ. cit.*, 1891, 392.

It really seemed as if it were impossible that a mole could escape this extraordinary person; wherever he struck his paddle, he found the mole's run; wherever he placed his trap, the mole was surely taken. His trap was of simple construction. It consisted of a steel instrument bent on itself like a pair of sugar-tongs, excepting that the branches crossed each other about their mid-length, so that the elasticity of the bend brought the extremities forcibly outwards and towards each other. The branches were held asunder by a square piece of iron with a hole through it, which the slightest touch would displace; and the animal, running along its passage, threw the trigger, as it may be called, and was caught by the branches springing sharply together. This appears to have been a very simple, certain, and effectual instrument; but it has been considerably improved upon in a trap now much employed in this country, in which the hinge, connecting the two branches, is placed in the middle, the spring behind, and the trigger before the hinge. A sort of box-trap has been recommended in some places, but it has the defect of being less certain; and at the same time it is not free from the objection of cruelty, as the animals are taken alive, and when several are confined in the trap together, they fight in the most desperate manner, wounding and even destroying each other. In the centre of England a very effective and simple trap is made by sticking into the ground a hard-wood stick, three or four feet long, to the free end of which a loop of fine brass wire is attached; the stick being bent down, the wire is made to pass through a hole in a small piece of board, into which a peg is introduced from below, to prevent the wire from being withdrawn by the elasticity of the stick. The board is so placed as to form a small portion of the roof of the run, and is firmly kept in position by sticks laid horizontally across it, which are held down at their ends by hooked pegs. The loop of wire passing through the board is opened below, so as to fit the inside of the run; and the peg, which keeps it from being drawn up by the spring-stick, projects downwards into the middle of the run. The mole, passing along, pushes out the peg, whilst its own body is within the wire loop, which is instantly drawn up, and the creature is speedily

killed. The Scottish mole-catchers, as Mr Evans informs me, use, instead of the board, a tubular piece of wood representing a short section of the run.

The Mole, owing to its underground abodes and the greater facility with which other animals which lie above ground can be procured, has, at least in Britain, few enemies. Dogs and foxes occasionally dig it out. Most of the short-winged hawks and owls—as shown by the bones occurring in their pellets—snap one up now and then when venturing above ground. Weasels,¹ and more rarely stoats, have been found or caught in the runs and have been seen carrying dead moles,² and sometimes they take possession of a fortress. But it does not appear to be proved that any of these animals make a systematic practice of mole-catching,³ and in captivity, as Mr Cocks informs me, they will only eat mole-meat when exceptionally hungry.

Moles have been occasionally kept for a few days in captivity, and they thrive well enough if they are supplied with a warm, dry bed, and if their inordinate hunger and thirst receive the constant attention which is essential. Young ones may be taken from the nest at any age and reared on cow's milk, which they drink readily. Their treatment presents no difficulties to people who are accustomed to look after young animals, so that it need not be described in detail.

Alston⁴ wrote a graphic account of one which he kept for nine days. It was the fiercest, boldest, and most voracious of animals. When regaled with the body of a frog it appeared to be possessed of a devil. It literally danced round its victim, worrying and biting at the skin of the belly until it tore it open, after which it feasted sumptuously on the entrails. This mole often carried its food underground; dragging the piece of meat to its heap of soil, it dived beneath it at one side, then turning itself, thrust out its head and pulled down the food after it. When it fed above ground its head was

¹ As known to Gilbert White (Letter xl. to Thomas Pennant, 2nd September 1774)—“Weasels prey on moles, as appears by their being sometimes caught in mole-traps.”

² H. Harden-Simpson, *Field*, 1st May 1886, 570.

³ A. H. Patterson, *Nature in Eastern Norfolk*, 311, 1905; also Knapp and Dutt, *op. cit. supra*, suggest that they do.

⁴ *Zoologist*, 1865, 9706-9708.

drawn back, its back arched, and its hands or fore paws turned so as to hold down the fragment, at which it tore with its little sharp teeth. Sometimes it fell asleep over its food, and awoke with renewed appetite; generally, however, it retired underground to sleep, coming out to feed every few hours. "The most amusing thing was to see him dive into the earth; first he grubbed a hole with his snout, then a few powerful strokes of his digging paws concealed the fore part of his body, and then his hind feet gave a kick in the air and disappeared."

One which Mr Adams kept alive in good health and vigour until, after eight days, he released it, was an enormous eater. When its food was a worm it would first seize it with its mouth and, holding it down with its paws, would feel the way with its snout to an end, as often one as the other, after which it would consume it from end to end by a series of short, quick jerks, now and then giving it a preliminary brushing with snout and paws to remove the dirt.

"On one occasion a large lobworm had burrowed nearly out of sight, when the mole came upon it, seized it, but instead of tugging at it furiously, as I had expected, and thereby breaking it, he held it taut, and presently yielding to the gentle tension, it was secured whole. This knowledge of the fragile nature of a worm, to say nothing of the ultimate consequences of haste and fracture, is remarkable, and the self-restraint on the part of so impetuous a creature is still more so."

Worms were undoubtedly the favourite food of this individual, but it also ate slugs without hesitation. It was offered freshly killed mice, but would only tackle them when there were no worms available, and then only when slit open. The heart, lungs, and intestines were the only parts touched.

Another account of a captive mole by the late Mrs Eliza Brightwen¹ differs from that of Mr Adams as regards the animal's method of eating worms. He pounced upon one "with the fury of a tiger, and holding it in his mouth, tore it to pieces with his sharp claws and rapidly devoured all the pieces, and snuffing about to make sure he had quite finished it, he then

¹ *Wild Nature won by Kindness*, 133, 1896.

darted off to seek another." This mole kept his velvet coat carefully brushed and licked by a tiny red tongue.

It is doubtful if such intelligence as the Mole possesses is, apart from its ordinary routine, of a high character. It seems to know how to avoid anything tainted by the touch of human hands, so that mole-catchers rub the inside of a trap with a dead mole before setting it, but the rapidity with which it becomes indifferent to being handled is suggestive of a dull brain. "When first caught," writes Mr Adams, "they squeak and bite viciously, but within an hour I have taken them up by the skin of the back without their protesting. I have frequently stroked and tickled my captives while they were engaged in eating, and I have held them up by the tail while they lapped water. I taught my last captive to come blundering along for food when I scratched upon the earth or the side of his box."

When angry or alarmed, moles can squeak¹ in a loud, shrill fashion, recalling the voice of a bat or shrew. But they have also other notes, one of which Mr Evans describes as somewhat like the purring of a cat or the distant jarring of a nightjar.

Mr Adams is nothing if not thorough in his studies of his favourite animal, so that it is not surprising to find him testing the gastronomic qualities of mole-flesh, with the result that he found baby moles excellent eating, "much like rabbit, the flesh being white and very tender."

Mole-skins were formerly accounted of some value, and even in times of depreciation, according to Mr Henry Poland, several thousands changed hands annually, at a price of about one penny to a penny farthing each, to be made up into waistcoats. One so made was composed of no less than fifty skins, and was highly commended by the editor of the *Field* for its lightness and warmth. Of late years, as I am informed on excellent authority, a fluctuating demand has arisen for the skins in the manufacture of ladies' coats.

¹ Alston, *Zoologist*, 1865, 9708 ; also, R. F. C., *Field*, 6th May 1876, 501.

Note.—Owen Jones has printed (*Ten Years of Gamekeeping*, 298) the description by an eye-witness of a mole gathering material for its nest:—"I heard a rustling

quite near me. I thought it must be a mouse. . . . Another rustle, and I saw a dead oak-leaf move. I sank on my knees, and crawled to the spot. Within a yard of my face I saw the pinky snout of a mole : never was more than the snout and head . . . to be seen : its body remained in one of those shallow surface-runs. With amazing swiftness the snout felt all round, and each dry leaf within reach would be grabbed and drawn under : in about ten seconds the mole would return. When there were no more leaves within reach of one opening, the mole would thrust through the surface in a fresh place, and continue its leaf-gathering with incredible energy." R. Kearton (*Wild Life at Home*, 129, 1899) states that he has once or twice seen moles come out for leaves, but he gives no description of their movements.

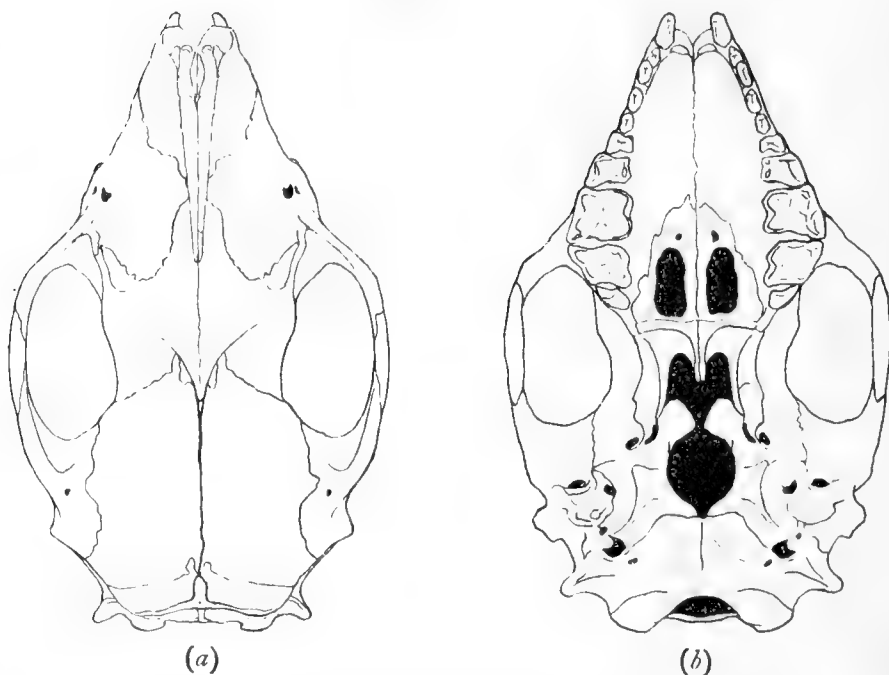


FIG. 21 A.—SKULL OF HEDGEHOG, *Erinaceus europæus*.
(a) from above ; (b) from below. Drawn by G. Dollman.

ERINACEIDÆ.

TRUE HEDGEHOGS.

GENUS ERINACEUS.

1758. ERINACEUS, Carolus Linnæus, *Systema Naturæ*, x., 52 ; xii., 75, 1766 ; based on *Erinaceus europæus* of Linnæus.

1868. HERINACEUS, Minà Palumbo, "Cat. Mamm. Sicilia, in Ann. Agr. Sic., 2nd ser., xii., 37." (Not seen ; thus quoted by Palmer.)

THIS genus, which includes one British species, is of wide **distribution**, and its many representatives are found numerous throughout Europe, Africa, and the greater part of Asia, but not in America, Madagascar, Ceylon, Burma, Siam, the Malay Peninsula, or Australia. Many of the species are very little known, but there may be mentioned my *E. roumanicus* (Matschie's *E. danubicus*), a dusky hedgehog with white breast-spot and peculiar skull characters, ranging from Bohemia and Roumania to Greece ; Satunin's *E. ponticus*, with a subspecies *abasgicus*, which I have not been able to examine, described from western Transcaucasia ; Schrenck's *amurensis* from Amurland ; Erxleben's *sibiricus* from Siberia ; Satunin's *ussuriensis* from the Ussuri country, Eastern Siberia, and *chinensis* from Chingan, Tyntza-intza, China ; Swinhoe's *dealbatus*, a pale form from China (Peking, Chefoo) ; Matschie's *kreyenbergi*, *tschifuensis*, and *hunensis*, all from China, and Thomas's *miodon* and *hughi* from Shen-shi, China. Allen's *orientalis* from Vladivostok is said to be externally of *europæus*-like type, but with quite distinct cranial characters (see my paper in *Ann. and Mag. Nat. Hist.*, April 1900, 360-368). Bate's *E. nesiotæ* of Crete is a somewhat small insular form.

The genus is not represented in America, but Matthew's *Proterix* (*Bull. American Mus. Nat. Hist.*, xix., 227, fig. 1, 9th May 1903), from the Oligocene beds of South Dakota, was

described as indicating a "True Hedgehog" of ancestral type, apparently intermediate in form between *Erinaceus* and *Gymnura* of the old world. These were also thought by Trouessart to be connected by his *Neotetragus sinensis* from western China (*Ann. and Mag. Nat. Hist.*, October 1909, 389-391), but Thomas has since shown (*Proc. Zool. Soc.*, London, 1911, 162, published March 1911) that the true affinities of this form are with the gymnurine *Hylomys*, without any special leaning towards the Erinaceinæ.

Hedgehogs are of considerable antiquity, and date at least from the upper and middle Miocene of European strata. The ancient Egyptians have left drawings of a member of the closely allied *Hemiechinus auritus* (*Nature*, 30th June 1904, 208; see also Keller, p. 20, fig. 7).

Generic characters:—The true hedgehogs are short-tailed insectivora with rudimentary caudal vertebræ, imperfectly ossified palate, and wide pelvis.

The upper surface and sides of the **body**, but not of the tail and head, are covered with spines, and, by the help of a special development of muscles, the skin of the back can be drawn downwards and forwards over the head and limbs. The animal tucks in its head into the interior of the "ball" thus formed, and is protected on all sides from ordinary attacks.

The **spines** are longitudinally grooved, the intervening ridges being smooth.

The **hair** is harsh.

The **ears** are very short, always less than half the length of the head (Plate V., Fig. 3).

There are six to ten paired **mammæ**.

In the **skull** the pterygoid fossæ are well developed, with the processes not hollow and taking no part in the osseous bullæ; the postglenoid process is much smaller than the post-mastoid, and its interior is solid, not hollow.

There are thirty-six **teeth** (Fig. 22, p. 54) arranged as—

$$i \frac{3-3}{2-2}, \quad c \frac{1-1}{1-1}, \quad pm \frac{3-3}{2-2}, \quad m \frac{3-3}{3-3} = 36.$$

The canines and anterior premolars are usually described as single-rooted, but vary very much in this respect.

Northern forms hibernate, but not those inhabiting southern regions, such as India.

The most nearly allied genus is *Hemiechinus*, instituted by Fitzinger for hedgehogs having the ridges of the spines tubercled, and recently revived by Satunin (*Ann. du Mus. Zool. de l'Acad. Imper. Sci.*, St Petersburg, xi., 1906, published 1907), to include *auritus*, *albulus*, and other long-eared forms.

THE HEDGEHOG OR URCHIN.

ERINACEUS EUROPÆUS, Linnæus.

1666. *Herinaceus* & *Erinaceus*, an Urchin or Hedgehog, Christopher Merrett, *Pinax*, 167.
1758. *Erinaceus europæus*, Carolus Linnæus, *Systema Naturæ*, x., 52 ; xii., 75, 1766 ; and all British authors, except as below ; described from Wamlingbö, South Gottland Island, Sweden ; see Thomas, *Proc. Zool. Soc.* (London), 1911, 142, published March 1911.
1803. *Erinaceus suillus*, Étienne Geoffroy, *Catal. Mamm. du Mus. d'Hist. Nat.*, 67 ; described from France.
1803. *Erinaceus caninus*, *Auct. et op. cit.*, 68 ; described from France.
1900. *Erinaceus europæus occidentalis*, G. E. H. Barrett-Hamilton, *Ann. and Mag. Nat. Hist.*, April 1900, 362-363, and *Ann. Scott. Nat. Hist.*, January 1901, 3 ; described from Innerwick, Haddingtonshire, Scotland (type specimen in British Museum of Natural History).

Le Hérisson of the French ; *der Igel* of the Germans.

Terminology :—The ordinary name of this animal, of which there are innumerable corruptions, is of a quite obviously English origin, though it does not appear before 1450. It occurs in a famous passage of Shakespeare :—"Thorny hedgehogs, be not seen" (*Midsummer Night's Dream*, II. iii. 10 ; see also *Tempest*, II. ii. 10, quoted below on p. 58, and (metaphorically) in *Richard III.*, I. ii. 104). On the other hand, it appears in the form *hedgepig* in *Macbeth*, IV. i. 2, in a passage quoted below on p. 74 ; and as *urchin* in *Titus Andronicus*, II. iii. 101 :—"Ten thousand swelling toads, as many urchins."

But the old English name was none of these, the Anglo-Saxon form being *īl*, a contraction of *igel* (compare the modern German *igel*, a hedgehog).

Urchin is derived from Old North French (*i.e.*, Norman or non-Parisian French) *herichun*, a form which appears as *hurchin* or *hyrchoune* in Scotland, as in Barbour (Early English Text Society, edited by Skeat, xii., line 353), and has many variants in different counties. The Latin type from which this word is derived was *ericionem*, a theoretical

extended accusative form from Latin *ericius*=a hedgehog; itself an extended form of Old Latin *ēr*=a hedgehog, cognate with Greek *χίρ*. *Ericius* occurs in the Vulgate.

Sex names:—Boar and sow.

Local names (non-Celtic):—*Furse-a-boar*, as in South Devon and Cornwall; *furse-man-pig* of Gloucester; *hedge-boar* or *hedge-pig* of Buckinghamshire, Somerset, Devon, Cornwall, South Worcester, and Wiltshire; *niceple*, *nisbil*, and *nyse-bill*, no doubt from the Anglo-Saxon *an ilespil*=a hedgehog's quill (*pil*=a dart), are, through popular confusion, employed as variants, as in Pembroke, and are all that now remains to represent the Anglo-Saxon *il*; *porpentine*, *perpynt* (?), *porcupig*, *pork-point*, and *porpin*, as in Pembroke and Somerset, being all derivatives of *porcupine* (itself from *porc-espín*); *prickle-back urchin* and *peggy-urchin* are longer forms of *urchin*, and have similar variants; *rock* (young) of Somerset; *sharpnails*.

(Celtic):—Irish—*gráineóg*=“the horrent one,” from *gráin*=“loathing” or “aversion.” Scottish Gaelic—*gràineag*. Manx—*graynag*; *arkan-sony* (Cregeen), both only found in dictionaries (Kermode). Welsh—*draenog*, *draened*=“spiny one”; *draen y coed*=“spiny of the wood”; *sarth* (?) *armell* (Pugh). Cornish—*sart*, *zart*; Mid-Cornish—*sort*=Welsh *sarth*.

Distribution:—Hedgehogs of this type range from sea-level to at least 8000 feet in the Caucasus (Blasius); and from about 63°, 61°, and 59° N. lat. in Skandinavia, Russia, and the Urals respectively, to the Mediterranean, including Sicily, Sardinia (Woltterstorff), Crete (Bate), and Asia Minor to Mount Lebanon; thence to Erzerum (Thomas), Trebizond, and probably right through to the Caucasus. West and east they are found from Ireland to Peking (Swinhoe), Aigun on the Amoor (Schrenck), the Ussuri country, and Vladivostok. A number of forms inhabit India, Afghanistan, Transcaspia, and Mesopotamia, in the two last of which, together with Cyprus (Bate), is found *Hemiechinus auritus* (Gmelin). *E. europæus* is not known from Arabia, Egypt, or Tunis, and in Morocco it is replaced by *E. algirus* of Duvernoy, which is also the hedgehog of the Balearics (Thomas and Pocock). An Andalusian specimen of *E. algirus* in the British Museum needs confirmation; perhaps, like a French record, it may have been due to introduction from the Balearics (see Siépi, *Feuille jeunes nat.*, Paris, 1909, 24-26).

In the **British Islands** *E. europæus* is probably common in every part of **England and Wales** (including Wight and Anglesey), the Lowlands of Scotland, and **Ireland**, where it has not been specially persecuted by man. In his first season as keeper in Hampshire, Owen Jones killed about one hundred and forty (*Ten Years of Gamekeeping*, 1909, 100). It is not particular about its surroundings, and frequents with impartiality the Yorkshire hills to at least 1300 feet (Clarke and

Roebuck), and the suburban gardens of big towns and cities. In Wales it has been found living at 1684 feet, and its dead carcase at 2500 feet (Forrest); but one said to have been found recently in Kensington Gardens, London (Harding, *Field*, 8th April 1911, 703), had most probably escaped from captivity. In **Man** it is now common everywhere, but, having no local names outside of dictionaries, is thought by Kermode to have been introduced early in the nineteenth century.

In the Lowlands of **Scotland** its numbers are certainly not less than in England. Alston, for instance, described it as "very common"; in Dumfries, Service has had no less than eight in full view within twenty yards (*Ann. Scott. Nat. Hist.*, 1901, 233); and close on a hundred were killed in 1903 on one estate near Edinburgh (W. Evans).

Its status in the mountainous parts of Scotland, although it ranges to the extreme north, is still somewhat obscure, and, now that it has been artificially introduced in many localities, is not likely to be satisfactorily explained. W. Evans collected a number of old records relative to the northern limits of its range at the close of the eighteenth and beginning of the nineteenth century. These are somewhat conflicting, but this much seems clear, namely, that the animal was at that time found well to the north both of the Forth and of the Tay. As pointed out by Evans, it was recorded for Tillicoultry, Clackmannan, in 1795; Dowally, near Dunkeld, in 1798; Forfarshire in "tolerable plenty" before 1813; and as far as the Moray Firth by 1828. Harvie-Brown and Buckley's "Moray" records of 1829, 1844, 1855, and 1862 show clearly that it was locally common in that area in the second quarter of last century. Its general reputation of late years is that of a species with an extending range, a point in regard to which many writers have been, perhaps, too prone to follow the lead of predecessors. In 1880 Alston recorded it as rapidly spreading to the northwards, but as yet unknown in Sutherland. Its status in that county, as well as in Caithness, is complicated by introductions, but there are records of its occurrence in the former by William MacKenzie (*Ann. Scott. Nat. Hist.*, 1897, 191) in 1872 and 1897; and in 1906 F. G. Gunnis wrote that it was increasing at Brora (*Journ. cit.*, 1906, 185). In Caithness, Lillie, a correspondent of Evans's, informed him that he has never seen a hedgehog, but "there have been stories of persons finding them," and "they are sometimes taken to Caithness from other districts as pets, and may possibly have sometimes escaped." Bruce, however, on the authority of MacNicol, states that five have been taken in the parish of Reay within the four or five years preceding 1907. There are also a few records from other mountainous districts, as East Ross and the adjoining parts of Inverness, where the animal was said to be plentiful in one of the wilder and less frequented glens in 1893 (Harvie-Brown and Buckley); West Ross, where it first appeared in 1890 [and is

supposed to have been imported in bales of hay !] (Hinxman and Eagle Clarke, *Journ. cit.*, 1903, 70); Argyll (Boyd Watt, *Journ. cit.*, 1901, 233-234; J. M. Campbell, *Journ. cit.*, 1902, 50; and Godfrey, 117); and the Dumbarton side of Loch Long, in 1900 (Evans, *in lit.*).

From the **Scottish islands** it is as a rule absent; but it appears in Mull vermin lists of 1825 at a reward of threepence per head (MacLaine of Lochbuie, *Journ. cit.*, 1895, 193); it is common in Bute (Colquhoun, *Sporting Days*, 101; also Boyd Watt), and has been trapped in the Mull of Kintyre (Harvie-Brown and Buckley). It has been introduced at Loch Tingwall, near Lerwick, Shetland (Millais), as well as in the Orkneys; in the latter it has not been since heard of (Harvie-Brown and Buckley); in the Shetlands it has been found near Cunningsburg, Mossbank and Loch Spiggie, Weisdale and Dale in Delting (Buckley and Evans, *Fauna of Shetland*, 1899, 57). Ussher found the bleached leg of one at a peregrine's plucking place on the South Saltee Island, co. Wexford, **Ireland** (*Zoologist*, 1886, 96). It occurs in **Jersey** and **Guernsey**, but in each case is said to have "been introduced" (Sincl).

Distribution in time:—This species is at least of pleistocene age in Britain, although the records are not always clear; witness Macpherson's allusions to remains found in the fissures of Helsfel, near Kendal. Andrews identified its bones from the debris of the neolithic lake-village at Glastonbury, Somerset (*Ibis*, 1899, 358), where it was a contemporary of *Pelecanus crispus*, and Jackson has lately obtained a single left upper molar from the cave-earth of Dog Holes, Warton Crag, Lancashire, a deposit of late pleistocene age (*Lancashire Naturalist*, 1910, 326). Leith Adams's record from Ballynamintra Cave, Co. Waterford, Ireland (*Trans. Roy. Dublin Soc.*, 2, i., 206, 1881), is stated by Scharff to have been an error. The latter's description of Ussher's collections from the Edenvale, Newhall and Barntick Caves of Co. Clare, Ireland (*Trans. Roy. Irish Academy*, Feb. 1906, i., 52, 64), are therefore very welcome. In these, hedgehog bones are present in abundance, mostly from the upper and more recent strata, but their position proves nothing, since their appearance was ancient and the superficial stratum of Newhall Cave contained remains of such extinct animals as the Gigantic Irish Deer, Reindeer, Banded Lemming, Bear, and Arctic Fox. Fortunately one distinct "find" hails from the lower stratum of Newhall Cave, thus placing the pleistocene age of the Hedgehog in Ireland also beyond doubt.

The **period of gestation** is probably seven weeks (Lilljeborg).

The **rutting season** is evidently early, since the **young**, the number of which, although usually about four, may reach eight, have been found in April. A second litter sometimes appears between the middle of August and the end of September (see also p. 73).

The **droppings** are sometimes very abundant, but are not always

easy to see except in places where there is no growing vegetation to hide them. They are very distinct in form and texture, of a pointed oblong shape, and a dry, loose texture very different from the strongly cemented droppings of rats or bats, and easily fall to pieces. Fragments of the elytra of beetles are generally conspicuous amongst them.¹ They are not specially odoriferous, but, in the case of captive animals at least, give off a peculiar semi-sweet stink, which is rather stronger than that emitted in the case of carnivores of a similar size.

Description:—The general form and appearance of the Hedgehog are typically those of its genus. It is a thick, stumpy animal, with neck and body shorter in proportion to its bulk than any other British mammal.

The **head** is conical; the ear short, broad, and rounded (Plate V., Fig. 3); the eye prominent; the legs short, bringing the animal's body nearly in contact with the ground when running; the tail a mere stump (Plate V., Fig. 4).

The **hands and feet** have each five toes, all armed with claws, and five pads. Of these, one lies at the base of the second digit, one at the bases of the third and fourth, and one at the base of the fifth. A pair of unequal size lie side by side behind these. The hand is well shown in Plate V., Fig. 1, and needs no further description. The foot is peculiar in the proportion of the digits (Plate V., Fig. 2). No. 1 is short, with a feeble claw; Nos. 2 and 3 are about of equal length, with strong claws, especially the former; No. 4 is shorter and has a smaller claw; No. 5 resembles No. 1, being quite short and with a feeble claw.

The **fur** is harsh and brittle, and is confined to the under surface, except the snout, forehead, cheeks, ears—and, sparsely, the tail. The rest of the body is thickly covered by spines.

The **spines** are arranged in radiating groups, and their most natural position is nearly flat upon the body, but they may be erected at will. They reach a length of about 20 mm., are sharply pointed, hard of texture, with, peripherally, 22 to 24 longitudinal grooves. Each is fixed in the skin by a hemispherical root, above which is a narrow neck bent almost at right angles. Perfect specimens can thus only with difficulty be pulled out from a living animal. On the other hand, pressure or violence applied to the tips is not expended in driving the spines into the body, but in bending the neck, a fact which explains why the animal has no fear of dropping on its back from a height (see *Carlier, Journ. Anat. and Phys.*, xxvii., new series, vii., 1893; and, for a popular figure, *Knapp, Journal of a Naturalist*, ed. ii., 1829, 139).

¹ "It appears, by the dung that they drop upon the turf, that beetles are no inconsiderable part of their food."—Gilbert White, Letter xxvii. to Thomas Pennant, 22nd February 1770. For much information on this subject I am indebted to Cocks and Moffat.

The spines are annulated with an alternation of dark brown or nearly black and white bands, usually three in number, of which the central is dark, leaving the two ends of the spine light. A small dark tip may or may not be present.

The haired surfaces vary in **colour** from dirty brown to dirty white, without discernible pattern. The variation is due to the proportions of hairs of these two colours. The majority of individuals are altogether brown, but in others the whitish hairs are numerous. Two small and very light skins in the British Museum were obtained by Ogilvie-Grant in Elgin, Scotland. In these the under side and nose are nearly white, with the exception of a dark, not very well defined breast patch and traces of a mid-ventral darkening.

The young, of which Gilbert White (Letter xxvii. to Pennant) noted that they have the eyes closed at birth, the spines white, soft, and flexible, and little hanging ears, are at first quite helpless. Patterson (*Irish Naturalist*, 1901, 254) describes an Irish litter, of which the individuals weighed .75 oz. (nearly 21 grms.) and measured 2.5 inches (63.5 mm.) in total length. The ears hung down slightly, and the snouts were short, broad, and unlike those of the adults. The soft, white, very small spines lay close down to the back. There were sharp and well-developed claws on all four feet, but no trace of hair on any part of the body. A deep, narrow groove ran down the centre of the back from head to tail. The colour was grey-blue above, fleshy beneath, the head being fleshy and the nose tipped with grey.

I find no trace of **moult** or **seasonal variation**, and it is not known whether the spines, which are, physiologically, modified hairs,¹ are under normal circumstances shed or renewed. Old spines lose the distinct pattern of their grooving, and their roots, which are quite deep when young, approach the surface (Carlier), when they could easily be thrown off and replaced by new ones; and this suggestion is supported by the fact that Cocks finds stray shed spines in his cages. An instance is on record where a hedgehog confined in a garden shed its spines in mid-winter (Ellen Newman, *Field*, 24th March 1906, 442). It was sent to the editor of the *Field* (*Journ. cit.*, 31st March 1906, 519), and eventually to the Museum of the Royal College of Surgeons, London. As an abnormality, the spines may be absent and replaced by hairs (see Cozens, *Journ. cit.*, 17th March 1906, 433; Fritsch, *Natural Science*, xiii., 156, plate ii., 1898).

In connection with the peculiarly helpless nature of the animal, especially during hibernation, Carlier's remarks on the **skin** are of great interest. On the upper surface it is very thick and provided with dense

¹ Compare: "One must regard as a kind of hair such prickly hairs as hedgehogs and porcupines carry"—Aristotle, *Historia Animalium*, ed. Thompson, 1910, I. 6, 490b, 28.

subepidermic tissue, but is poorly supplied with blood-vessels and without sebaceous and sweat glands. The thickness is no doubt a means of protection, and prevents loss of heat by radiation during hibernation. The skin of the ventral surface is, on the other hand, highly vascular and resembles that of other mammals. Much fat may accumulate on the back, especially in autumn.

In the **skull** the palate bones have two large unossified spaces, situated in front of a transverse ridge just behind the posterior molars; the pterygoid fossæ are very broad; there is no alisphenoid canal; the mesopterygoid is deep and leads posteriorly into a deep hemispherical excavation lying between the auditory bullæ. The sagittal crest may be well developed in specimens so young that the permanent dentition is only just appearing.

The shape and extent of the premaxillary frontal processes are subject to much variation. In many specimens they are conspicuous, extending backwards for more than half the length of the nasals and with their posterior terminations not sharp or pointed, but blunt or square. This character was at one time supposed to be constant and of sub-specific value in British specimens, and upon it was based the description of *E. europæus occidentalis*. Examination of a larger series shows that this is not always the case (see Lönnberg, *Ann. and Mag. Nat. Hist.*, June 1900, 542), but the question cannot yet be regarded as decided.

Some of the **teeth** are quite variable in size, especially the second upper incisor and central upper premolar, the former a point of importance because the lesser dimensions of this tooth were fixed upon by de Winton (*Proc. Zool. Soc. (London)*, 1897, 955-956) as diagnostic of *E. algirus*. Although usually far larger in *E. europæus*, this tooth may be occasionally quite small. The central upper premolar is sometimes absent or crowded out of the tooth-line. As regards roots, Hollis (*Zoologist*, 1910, 325-6), examining eleven specimens, found the third upper incisor invariably single, the upper canine six times double, once single, and four times intermediate, *i.e.*, single but with indications of fusion of two roots.

In the upper jaw the central incisors are long and robust, separated and distant throughout their length, their points slightly converging; the second and third pair, particularly the second, are small and conical, resembling premolars. There is a space between the third and the canine, both of which are usually stated to have single roots, but are very variable in this respect. Of the three premolars, the first two are smaller than the third, which has three roots, and an anterior outer cusp so very large as to resemble the carnassial tooth of a carnivore. The first two molars are large, nearly quadrate, and furnished with strong acute tubercles; the first molar is the largest of all the upper teeth, the third is small, placed obliquely, and has to some extent a cutting edge.

In the lower jaw the central incisors, which in shape and size resemble those of the upper, are directed nearly horizontally forwards. There follow three small teeth, obliquely cusped, the second of which is the canine, the third a premolar. Following these, but separated by an interval, is another premolar, a prominent but narrow tooth



FIG. 22.—SIDE VIEW (diagrammatic and magnified $1\frac{1}{2}$ times) OF TEETH OF *Erinaceus europæus*.

of height equal or superior to that of the molars; it carries externally two principal cusps and an inner rudimentary one. To it succeed the three molars; the first, the largest of all the lower teeth, has five well-marked cusps; the second is smaller, with four sharp cusps and an anterior rudimentary one; the third is smallest, with one pointed inner posterior cusp, and two rudimentary.

Individual colour variation runs mainly in the direction of albinism, of which, partial or complete, a number of instances are on record¹ (see Spicer, *Zoologist*, 1858, 6058; Bainbridge, *Field*, 13th April 1861, 313; Harding, *Zoologist*, 1879, 172; Maud Stevenson, *Field*, 29th September 1888, 476; Evans, *Journ. cit.*, 6th October 1888, 509; Allenby, *Journ. cit.*, 9th November 1889, 667, and 19th April 1890, 587; Hardbottle, *Zoologist*, 1895, 346-347, and *Field*, 7th September, 1895, 439; W. J. Clarke, *Zoologist*, 1903, 387; Reid, *Field*, 19th December 1908, 1103; and many others). Details are, as usual in such cases, seldom given, but in one instance the sex is said to have been female (Prior, *Zoologist*, 1879, 172); in another, a mother and at least one of her young were albinos (exhibition by Earl of Haddington, *Proc. Nat. Hist. Soc.* (Glasgow), iv., 37, 1878-1880). A true albino recorded by Chapman (*Field*, 15th August 1903, 327) is stated to have been little more than half grown, but I suspect that some of the juvenile albinos recorded were merely very young ones in which the pigmentation of the spines had not yet made its appearance. A family of milk-white hedgehogs

¹ Millais has seen about twenty specimens.

in Charles Waterton's park at Walton Hall (*Zoologist*, 1866, 195; see also "Tye (Horsham)" = Bainbridge, *Field*, 16th August 1862, 161) are stated to have been nearly full grown; their mother was of normal coloration. In one case a hedgehog having white spines was dissected, when the nerves connected with the subcutaneous muscles were stated to have been much diseased (Harper, *Zoologist*, 1851, 3022-3023).

Geographical variation manifests itself in colour, and, as regards the skull, in the shape of the frontal processes of the premaxillæ. My conclusions on the latter point have, however, as has been stated above, been disputed by Lönnberg; but it should be remembered that they were true for the series of specimens at that time in the British Museum, and they may be reinstated when a really satisfactory series becomes available for examination. Southern specimens tend to become white, the extreme being represented by my *E. e. hispanicus* of south Spain, a form with inconspicuous frontal processes to the premaxillæ. My *E. e. italicus* of Italy is not so pale, and in skull agrees with the typical form of Skandinavia, in which the above processes are sharply pointed. My *E. e. consolei* of Sicily has long thin bristles with broad, white, strongly contrasted, dusky annulations. *E. e. concolor* (Martin) from Trebizond and Mount Lebanon is externally very similar, but may be distinguished by its smaller teeth and skull. I have not examined *E. e. transcaucasicus* of Satunin.

During **hibernation** some remarkable changes take place in the tissues, as described by Carlier (*op. cit.*, *vide supra*, p. 51). That they are all altered in constitution, is shown by their being less readily acted upon by staining agents than when the animal is active.

At the commencement of hibernation the blood undergoes a profound change, the number of white corpuscles dropping suddenly from about 20,000 or 18,000 to 3000 or even 1000 per cubic millimetre. At this time the white corpuscles seem to invade the connective tissue of the mucous and submucous coats of the intestinal tracts. Their probable function is to devour the bacteria, which, as Bouchard ("Essai d'une théorie de l'infection," *Proc. Tenth Medical Congress*, Berlin, 1890) has shown, pass from the alimentary canal through the tissues into the blood of an animal which is cooled or chilled. Their work is soon accomplished, and they degenerate and are removed. The blood then slowly but surely acquires its normal proportion of corpuscles.

The lymph-glands also undergo important changes, probably with a view to cleansing the lymph-stream from impurities tending to accumulate during hibernation.

A special bilateral organ, the hibernating gland, lobulated in shape and orange-brown in colour, is situated chiefly in the axillary, cervical, and dorsal regions. Apart from differences due to age or nutrition, it

varies greatly in size at different seasons of the year. It is most voluminous in October, and at that time equals about 3·04 per cent. of the animal's total weight. During the early part of hibernation it rapidly diminishes, and at the beginning of January is only about 1·5 per cent. of the total weight, or, allowing for loss of weight by the whole animal, only ·33 of its own original weight. By the end of March it is only ·9 per cent. of the total weight; and, continuing to atrophy, is by June reduced to a few fibrous cords. Thenceforward it increases until the commencement of the next hibernation.

This gland probably acts as a storehouse for fat, which accumulates in it so long as the animal feeds. During hibernation it gives up the fat and probably becomes transformed, a few cells at a time, into highly nutritive matter, fat alone being not sufficient to sustain life.

DIMENSIONS IN MILLIMETRES:—

	Head and body.	Tail (without terminal hairs).	Hind foot (without claws).	Ear.
MALES.				
1.* Louth, Lincolnshire, 14th October 1910	210	35	42	35
2.* Do. do. (undated)	258	34	48	32
3.* Tetbury, Gloucestershire, 11th November 1910	188	22	40	29
4.* Do. do. (undated). . . .	220	24	42	28
5. Cardiff, Wales, 26th May 1899 (R. Drane; Brit. Mus. Nat. Hist.)	263	20	43	22
6. Innerwick, Haddington, Scotland, 8th April 1899 (W. Eagle Clarke; Brit. Mus. Nat. Hist.; type of subspecies <i>occidentalis</i>)	218	17	42	28
7. Ennis, Co. Clare, Ireland, 21st September 1893 (T. W. Scott; Brit. Mus. Nat. Hist.)	252	30	40	..
Approximate average of seven adult males, as above	230	26	42·5	29 (6 items)
FEMALES.				
1.* Louth, Lincolnshire, 14th October 1910	194	20	37	31
2.* Do. do. (undated)	232	24	42	30
3. Oundle, Northamptonshire, 20th November 1900 (Brit. Mus. Nat. Hist.)	257	31	40	26
4.* Richmond, Surrey, 10th December 1910	195	18	39	25
5.* Do. do. (same date). . . .	217	30	36	26
6.* Tetbury, Gloucestershire, 11th December 1910	207	28	36	29
7.* Do. do. (undated). . . .	230	24	41	29
8. Exeter, Devon, 21st September 1907 (E. Hollis)	212	21	37	20
9. Topham, do. 8th October 1907 (E. Hollis)	232	21	38	22
10. Cardiff, Wales, 26th May 1899 (Brit. Mus. Nat. Hist.)	194	17	34	24
11. Immature, Haddington, Gloucestershire, 15th Nov. 1894 (R. Hooper; Brit. Mus. Nat. Hist.)	179	23	35	21
Approximate average of ten adult females, as above	217	23·5	38	26

* Measured by T. V. Sherrin, to whom I am indebted for particulars.

The table suggests that males are larger than females; see also the weights given below.

Skull:—Greatest length, 55 to 57; basal length in middle line, 53 to 57; palatal length in middle line, 42 to 43; length of upper tooth-series, 28 to 29; same in lower jaw, to tip of incisor, 26; greatest breadth

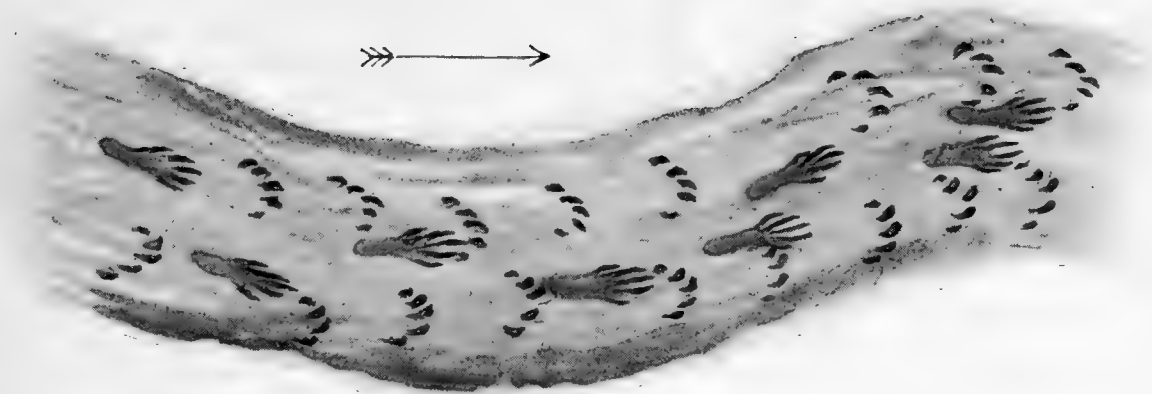


DIAGRAM OF MOLE'S TRACKS IN SNOW. (Reduced ; after Adams.)

The tracks made by the hind feet are shown as elongated marks nearer the centre, those of the fore feet as semicircular impressions nearer the margin of the diagram.

These tracks were illustrated, but with less detail, by the late Mrs Eliza Brightwen in *More About Wild Nature*, 1892, 117.



at zygoma, 34 to 36; posterior breadth, 31; breadth between orbits, 17 to 18; breadth at constriction, 14 to 15.

Weight:—The Hedgehog, being a hibernating animal, probably varies considerably in weight at different seasons of the year, being theoretically heaviest just before and lightest some time during hibernation. Although this is probably true, there are no detailed supporting observations. Webb's results (*Zoologist*, 1876, 4824-4825) were vitiated by the fact that the Irish pair which he weighed at weekly intervals throughout the year lived in the partial confinement of a garden, and were fed on bread and milk in winter. He found that the male was nearly always heavier than the female, especially in May and June; he reached his maximum of 2 lbs. 7 oz. in the third week of May, and dropped to his lightest in December and January (1 lb. 7.5 oz. to 1 lb. 8.5 oz.). The female seemed to follow a different cycle, since, although also lightest in December and January (1 lb. 6 oz. to 1 lb. 7.5 oz.), the heaviest weight she reached (1 lb. 15.5 oz.) was in the last week of October, in which week and the previous one, she—for the sole time in the year—was slightly heavier than the male. It would be interesting to correlate the variation in weight with the accumulation of fat, supposed to be greatest in autumn just before hibernation, at which time Webb's male specimen was steadily losing weight. The extremes of weight, running from 1 lb. 6 oz. to 1 lb. 15.5 oz. in the female, and from 1 lb. 7.5 oz. to 2 lbs. 7 oz. in the male, agree with such isolated records as I have been able to inspect; but the experiment needs confirmation with wild animals, great care being taken that the results should not be upset by irregular feeding.

Wadham writes me that he examined a very large Isle of Wight specimen; the weight was 3 lbs. 8 oz., so that it appears to have been an exceptionally heavy animal.

Although at first sight deprived by its structure of all means of attacking its enemies, of defending itself by force, or of seeking safety in flight, this animal is yet endowed with a tolerably effective safeguard in its close covering of sharp spines. These being hard without being brittle, sufficiently elastic to bear great violence without breaking, and fixed with astonishing firmness in the tough leathery skin, form not only a solid shield-like protection from the effect of blows or falls, but a shirt of prickly mail sufficiently sharp and annoying to deter all but the most resolute of dogs from venturing an attack. The moment a hedgehog is touched, or perceives danger approaching, it rolls itself up into a compact round ball, by the

contraction of the powerful fibres of the panniculus carnosus muscle which covers the body immediately under the skin ; and thus it presents to its enemy an impenetrable panoply, beset by innumerable spines standing out in every direction. The more it is irritated or alarmed, the more firmly it contracts, and the more strongly and stiffly the spines are set ; and its appearance at such times did not escape the eye of Shakespeare, who put the following into the mouth of Caliban :—

“ Then like hedgehogs, which
Lie tumbling in my barefoot way, and mount
Their pricks at my footfall.”

—*The Tempest*, Act ii., scene 2, line 10.

Bell, remarking on the strength and elasticity of this covering, states that he repeatedly saw a domesticated hedgehog run to the wall of an area, and, without hesitation, throw itself over. Contracted into a ball, it fell twelve or fourteen feet, and, immediately afterwards unrolling, ran off unhurt.¹

The assertion of Pliny,² followed by his numerous plagiarists, that the means of defence just described are aided by another of a very different character—the expulsion of the urine, in such a manner that it spreads itself over the whole surface of the skin, and by its odour disgusts and repels an assailant—is doubtless based upon the incontinence of the terrified animals. But it may also have reference, as suggested to me by Mr C. B. Moffat from actual experience in this direction, to a genuine, but not invariably used power of emitting an unpleasant smell under the influence of fright. By the Romans this assertion was doubtless read with reference to a different object—namely, the supposed rendering useless by this defence of the prickly skin, which they used in hackling hemp for the weaving of cloth. Apart, however, from its own unsavouriness, the numerous fleas and other parasites which often make the Hedgehog their host render its examination at close quarters far from pleasant.

The suggestion advanced above, that the Hedgehog is

¹ And this observation has often been since confirmed, as by R. I. Pocock, who writes me that he has often seen hedgehogs, in dropping from a table, slightly slide off, turning in the air, so as to alight back downwards on the floor. See also below, page 71.

² viii., xxxvii.

capable of emitting an unpleasant smell under the influence of fright, will probably be regarded as controversial. It is so interesting, that Mr Moffat's observations may be given in detail in the hope that further evidence, corroboratory or the reverse, may be forthcoming. The animal is not usually regarded as particularly odoriferous, and its presence may not appeal directly to human nostrils; but there can be no doubt that it does possess a peculiar, definite, and comparatively strong odour, which is so unmistakable that dogs can be readily trained to hunt for it.¹ The possession of a peculiar and unpleasant odour by an animal which is at the same time palatable, painful to handle, and easy to see or find in the open at night, would be a natural combination of characters already shown by Mr Pocock to occur in the somewhat similarly equipped porcupines,² in which, however, it is accompanied by even more conspicuous coloration.

Mr Moffat's experience was obtained by putting a hedgehog into a water-butt for the purpose of seeing it swim. Immediately on finding itself in the water, the animal emitted an effluvium so powerful that he had to run back five or six yards to find an atmosphere in which he could breathe. "It was quite an unpleasant work," he writes, "afterwards to release the poor creature from its swimming-bath. . . ." He adds that he is not morbidly sensitive to odours, but the result of his experiment as related above beat anything on the part of a live animal that he ever encountered before or since. Mr Moffat subsequently gave another hedgehog a bath to see if it also would act skunk, but he was disappointed to find that it did not. But his previous experience is partially borne out by his observation that a fairly strong odour is sometimes produced when hedgehogs are fighting at night, but this is "nothing whatever" to the stench made by the animal that he put into water.

It looks as if the animal's general behaviour is guided

¹ As pointed out by many writers; see Knapp, *Journal of a Naturalist*, ed. 2, 1829, 135; also, Sir William Jardine's *Supplementary Notes* to Jesse's edition of White's *Selborne*, 1854, 404-5. It is "A peculiar, frousty, semi-sweet smell, which also clings to the droppings."—Cocks, *in lit.*

² Of the genus *Hystrix*; see *Proc. Zool. Soc.* (London), 1906, 902, published April 1907, also 1908, 946, published April 1909; and *Field*, 11th March 1911, 489.

by its protective coat of prickles, or, as Mr Moffat puts it, that it trusts a good deal in its own comparative immunity from attack. Thus Mr Moffat finds that when moving about by night it does advertise its presence by sounds, making a furious sniffing with its nostrils, and also rustling among the leaves and herbage in a way that no other small animal could do without great unwisdom. "One can easily track Hedgehogs—I think from a distance of 40 yards—by the perpetual noise they thus keep up, which tells us both *where* they are and *what* they are."

Enough has been written above to suggest that the Hedgehog possesses the attributes both of smelling and self-advertising, but it would be desirable that further observations should be made on so interesting a subject. Some exotic hedgehogs are evidently further advanced on the same path, for their tints are brighter and more nearly approach the category of "warning coloration," and, according to Captain T. Hutton,¹ an Indian species² makes a grunting sound when irritated, and when touched suddenly, jerks up its back so as to throw its spines forward, making at the same time a noise like a puff from a pair of bellows. This action at once brings it into the same category as a porcupine.

Whatever may be thought of the above conclusions, two facts are incontrovertible—viz., firstly, that the Hedgehog is a palatable beast, acceptable, apart from sentimental prejudices, both to man and to carnivorous animals; and secondly, that despite its prickly armour, many animals eat it, especially when it is young and lacks the defence of the adult's spines. This does not mean that the prickles are not protective, but merely that they can be overcome by an enemy which is so hungry that it will put up with wounds so long as it obtains a meal. Even so, the effect of the prickles is to make carnivorous animals think twice before attacking a hedgehog, and thus to cause them to seek other food first.

The flesh is eaten by men in some parts of continental Europe, where the human dietary is wider than in Britain. But even in this country it must have been at one time considered a delicacy by the cultured, since "hyrchouns"³ were served at a feast in 1425.

¹ In W. T. Blanford.

² *E. collaris* of Gray and Hardwicke.

³ See F. J. Stubbs, *Zoologist*, 1910, 155.

It is still eagerly sought after by gypsies and others,¹ who are very fond of it, but the few refined people who have tried it give very contradictory accounts of its quality. Probably the objections are due to prejudice, for Mr Pocock writes me that he knows hedgehogs to be delicious eating, having supped off them in the Balearic Islands; and Mr Owen Jones gives directions² for broiling them, taken at first hand from the gypsies; he remarks that you are lucky if you can obtain them in late autumn, for by that time they have encased themselves in fat against the days of their winter sleeping.

It is not at all certain how carnivorous mammals overcome the defensive armour, but there can be no question that they do so at least occasionally. It frequently happens also that a well-trained dog is found bold and active enough to "open" a hedgehog, at the expense of a bloody nose and sorely pricked paws. The siege is often of long duration, and success in some cases probably results rather from relaxation of its guard on the part of the tired victim than from the actual victory of brute force. The smallest grip on the unprotected portions of the body is decisive. A clever plan of campaign is described by Mr J. G. Millais, who once observed a dog kill one of these animals by scratching away with the nails of his fore paws until he had made an entrance large enough to fix one paw against the poor brute's chest. With the other he drew up the head, forced it back, and a nip on the throat finished the tragedy.

The Fox, the Badger,³ and the Polecat are all credited with the power of despatching the Hedgehog, in the last case on the authority of H. A. Macpherson. He is not, however, very definite, and merely remarks that two of his correspondents

¹ As in Essex, *vide* H. Laver, *in lit.*

² In *Woodcraft*, 1910, 147; as did F. T. Buckland in *Curiosities of Natural History*, edition of 1879, series 2, 129, etc.; and Millais also, from information supplied by F. H. Groome.

³ "Few people are aware probably that its chief enemies are the badger and the fox. Where they dwell hedgehogs are not likely to become too numerous."—J. E. Harting, *Vermin of the Farm*, 1892, reprint, 35. There is a remarkable note in the *Field* of 23rd March 1875:—"The pitiful wail of a hedgehog when caught by a badger is not easily forgotten, for although he will curl himself up and be torn to pieces by a terrier without a cry, the moment a badger approaches him he commences the most piteous cries, and death seems long and painful, for the badger sucks the blood before devouring the body."

found the remains of hedgehogs in the Fougart's larder; but Mr A. H. Cocks finds that captive polecats will consume even the prickly skin, devouring the bristles clean from within. In any case, there can be no doubt that both foxes and badgers eat hedgehogs, both dead and alive, although, finding young ones easier to kill, they probably attack adults only when they are very hungry. In overcoming the prickly armour, Mr Millais thinks that foxes may possibly use the tactics so successfully pursued by the dog which came under his observation, as already described.¹ Colonel J. S. Talbot writes me, however, that the method employed is to seize the prey before it has had time to completely roll itself up, there being always a moment of hesitation following the first alarm.²

Mr Moffat tells me that hedgehogs are eaten by rats,³ but it is sometimes uncertain which party is really the aggressor, since hedgehogs are themselves nothing loth to attack rats, and will certainly do so in captivity, as observed by Mr Pocock. They have been seen to do so by a correspondent of Mr G. A. Passingham's,⁴ and instances are on record⁵ where they have freed a garden of these rodents. On this point an anecdote of the late J. C. Mansel-Pleydell's⁶ is illustrative both of the conflicts which occur between hedgehogs and rats, and of the activity displayed by the former, although apparently so clumsy. He relates that at about eleven o'clock one moonlight night loud cries were heard in the branches of a virginian creeper under the eaves of a house at a height of twenty feet from the ground. The cries gradually came nearer, until a rat and hedgehog fell to the ground together, the latter with visible marks of the rat's teeth upon its body. Mr Lionel E. Adams also sends me an instance of a hedgehog killing a large rat, but the former itself succumbed to its injuries a day or two later.

The above remarks lead to a consideration of the Urchin's carnivorous propensities. These, unfortunately,

¹ For the Hedgehog's sake it is to be hoped that the plan adopted is not that detailed by Topsel, the nature of which prevents its repetition here.

² See also article on *Fox*.

³ See also, for a description of such an encounter, G. C. Green, *Field*, 9th January 1892, 35.

⁴ *Field*, 30th November 1895, 903.

⁵ Lord Lilford, *Zoologist*, 1890, 453.

⁶ *Field*, 16th November 1895, 827.

although often denied by partisan writers, can no longer be glossed over by an impartial historian. The animal has many defenders, but its predilection for eggs, game, and poultry has long stood on record,¹ and is supported by the convincing testimony of a host of recent accusers. Details of its exact delinquencies, although some account of its methods of feeding and hunting may be acceptable, would therefore seem to be superfluous. It may be remarked in its favour that its attentions to eggs may in the first instance arise from a love of warmth rather than from malice prepense. An outlying barndoor hen has been found sitting on her uninjured eggs with a hedgehog's prickly body interposed between her and them!² No doubt, however, the first breaking of an egg would give the hedgehog, at first innocent, a guilty knowledge of their nature; and the presence of the unwelcome intruder in a pheasant's or partridge's nest can be scarcely more conducive to successful hatching than if it destroyed the clutch wilfully and without hesitation.³

But, in spite of all that has been said, it is correct to write that its usual aliment consists of beetles, worms, slugs, snails, and various other insects and invertebrates, in search of which it is fond of grubbing in cow-dung.

Its fondness for insects makes it a useful pet in the basements of houses where such pests abound, and, were it to restrict its operations to the pursuit of such small game, there is no doubt that it might be set down as a creature useful to the farmer and harmless to the game-preserve. In the neighbourhood of big cities, in market-gardens and pasture-lands, its presence may be entirely beneficial.

But the changed conditions brought about by game,

¹ See, for instance, Rev. J. C. Atkinson, in *Zoologist*, 1844, 791; several other letters on the same subject in the *Zoologist* were collected in *Letters of Rusticus*, 1849, 111-115.

² M. S. Young, *Nature Notes*, 1901, 16-17.

³ Many individuals seem never to have learnt the nature of the contents of large eggs, and in captivity do not know how to reach them until the shell has been broken (see Atkinson, *loc. cit. supra*). Few, if any, mammals, even if otherwise confirmed egg-eaters, recognise cold fresh eggs as eatable, although they will devour them freely when warm, especially if containing a nearly hatched chick. But the five captive hedgehogs of which R. Drane writes me that, even when hungry, they refused eggs, whole or broken, boiled or fresh, must have surely been exceptional.

the extermination of the carnivorous mammals, and the increase in numbers of helpless game-birds and their eggs, have forced the Hedgehog into a position which it might not otherwise have occupied. Its numbers become excessive, and its dietary consequently enlarged, until it starts poaching and falls under the bann of extermination.

It has often been stated that hedgehogs will eat many vegetable substances, including succulent leaves such as those of the dandelion and lettuce.¹ But Mr Cocks informs me that a pair in his possession could not be induced to touch raw vegetables, and it seems likely that such substances would not be highly relished by such a confirmed animal-eater.

Its recorded dietary is, however, a wide one, and is said to include acorns, wild fruits, apples, swede turnips, toadstools, bees² (honey³ or bumble) and wasps⁴ (which it has been found eating at their nests or hives), frogs,⁵ young or wounded birds, mice, and, when they can be secured, rats and rabbits. All sorts of offal attract it, and it falls a victim to baits, such as entrails and flesh or bread and aniseed, intended for the destruction of other very different animals.

It has been accused of seizing a hare by the hind leg.⁶ In fact, it will eat any living creature which it can overpower, and almost any dead one. That it will devour even snakes when opportunity offers, may be taken for granted. But that such a practice is habitual to it may well be doubted, most

¹ In Cyprus the Long-eared Hedgehog, *Hemiechinus auritus*, feeds on grapes, and the Cretan representative of our own species will eat oats; see Miss D. M. Bate, *Proc. Zool. Soc.* (London), published 1st April 1904, 343, and 5th April 1906, 317. Gilbert White's statement that hedgehogs "eat the roots of the plaintain in my grass-walks" (Letter xxvii. to Thomas Pennant), has been shown to have been an error, the damage having been the work of a caterpillar (see *Letters of Rusticus* 1849, 110-115).

² W. D. Crotch, *Zoologist*, 1850, 2637

³ William Storey, *Mammals of Upper Nidderdale*, 1885, 195.

⁴ Max Peacock, *Naturalist*, 1st October 1900, 320.

⁵ Toads have also been included, but probably in error. Cocks cannot induce any mammals to eat them in captivity: but Pocock writes me that he has seen a tame white rat lapping the blood of a toad which it had wounded. No doubt, but for his intervention, the rat would have killed the toad.

⁶ M. A. Matthew, *Zoologist*, 1887, 233; and William Thompson quotes the *Gardener's Chronicle*, 1846, 480, for an assault upon a leveret.

so-called experiments¹ having merely shown that when the two animals are confined in a box together the ensuing conflict provides the urchin with its supper. There is usually nothing to show that the conflict was desired by either of the combatants. The hedgehog's plan of campaign is to snap quickly, and then instantaneously to present its armoured back to the reptile, which, if poisonous, beats itself to death against the erect spines. This has been observed by several naturalists, as, for instance, by Mr Harting,² in the case of captive specimens,³ and also by Richard Kearton,⁴ who watched one kill a slow-worm with similar precautions. Mr Pocock also informs me that the same procedure was adopted on one occasion in the case of a rat, the hedgehog approaching the rodent sideways and keeping its spines directed towards it.

The battles of hedgehogs and snakes have been recounted with more or less embellishment by many authorities from ancient times. Topsel's version has at least the virtue of picturesqueness, and on that account alone deserves quoting.

"There is," writes Topsel, "mortal hatred betwixt the Serpent and the Hedge-hog, the Serpent seeketh out the Hedge-hog's den, and falleth upon her to kill her, the Hedge-hog draweth it self up together round like a foot-ball, so that nothing appeareth on her but her thorny prickles; whereat the Serpent biteth in vain, for the more she laboureth to annoy the Hedge-hog, the more she is wounded and harmeth herself, yet notwithstanding the height of her minde, and hate of her heart, doth not suffer her to let go her hold, till one or both parties be destroyed.

"The Hedge-hog rowleth upon the Serpent, piercing his skin and flesh, (yea many times tearing the flesh from the bones) whereby he scapeth alive and killeth his adversary, carrying the

¹ As of Rev. William Buckland, see W. J. Broderip, *Zoological Journal*, ii., v., 19, published April 1825; also of F. T. Buckland, *op. cit.*, edition of 1879, series 2, 132.

² There is a translation of a French version in *Zoologist*, 1887, 306; and Harting refers me to *Le Chasseur François (St Etienne)*, 1st June 1898, and to *Chasse et Pêche*, (Brussels), 24th June 1894, for other recent accounts, but I have been unable to see either journal.

³ *Vermin of the Farm*, 1892, reprint, 33.

⁴ *The Fairyland of Living Things*, 1907, 95.

flesh upon his spears, like an honourable banner won from his adversary in the field."

Before leaving this question it may be well to direct attention to the Urchin's apparent immunity to snake poison.¹ But it is in other respects also abnormal, being in my experience difficult to drown, and it has the reputation of being proof against many poisons.

Hedgehogs are dirty feeders, writes Alston,² whose account of the animal is very lively. Like other carnivores, they soil their food and carry parts of it that they cannot eat to their sleeping places, where they are content to repose on a mass of putrifying meat. They lap milk like a dog, but bite sideways in pig-like fashion. The contents of eggs are licked out through a hole in the shell, which is kept constantly enlarged as the requirements of the banquet demand. Portions of the shell may be swallowed, but are not digested. Unlike the weasels, which seize their prey by the back of the head, hedgehogs, like moles, shrews, and rats, attack the abdomen, in order to devour first of all the entrails; if necessary they eat their way into the still-living victim, turning the skin neatly inside out as they proceed. They will crunch the bones of so comparatively large an animal as a mole, but, at least in captivity, seem to be unable to cut the tough skin with their teeth.³ Alston stated that in eating they smack the lips loudly, and undoubtedly they make what Atkinson called "a singularly harsh sound" over their meals. But this, as Mr Cocks writes me, is probably due to "staccato" chopping movements of the teeth.

The smaller victims are chewed with cruel deliberation. Leonard Jenyns⁴ has well described how a worm was seized by one extremity and gradually eaten to the other, and Mr Harting's specimens tore frogs limb from limb.⁵ There is some difference of opinion as to the treatment meted out to snails. Mr H. L. Orr⁶ writes, for instance, that they are separated from their shells before being swallowed, whereas Mr Moffat declares that they are crunched up, shells and all. The latter adds that he has seen

¹ See G. Physalix and G. Bertrand, *Revue Scientifique*, 8th August 1896, 189.

² *Zoologist*, 1866, 58-60; Atkinson's account (*op. cit. supra*) is also excellent.

³ *Fide* Adams.

⁴ *Observations on Natural History*, 1846, 61.

⁵ *Op. cit.*

⁶ *Irish Naturalist*, 1899, 628.

wild hedgehogs eat a black slug of a kind which he believes that most birds reject.¹

Most authorities agree in stating that shrew-meat is one of the few possible foods that a hedgehog cannot face. Sir Oswald Mosley² stated that one died under his observation within an hour of its having mouthed a shrew's carcase, but it must have owed its death to some other cause. It would hardly have been abroad at noon if in good health. Be that as it may, the late Robert Service threw the strong weight of his testimony into the opposite scale, writing me that he had not the least doubt that the Hedgehog is the principal cause of the mortality which is so well known amongst the shrews at certain seasons. Unfortunately, he was never actually present at such a tragedy, and could not be sure that the supposed victims were ever eaten. It will, therefore, be well to suspend judgment on this point.

Service found that hedgehogs destroy a good many eggs of birds nesting on the ground, especially skylarks, but that the destruction is mainly done on the day or evening before the eggs are due to hatch. He believed that, perhaps, the condition of the eggs is recognised by some peculiarity of smell, since in his experience young birds or fresher eggs were rarely taken.

Hedgehogs are as quarrelsome as other insectivores. Alston³ remarked that his captives, when fighting, tried to seize each other either by a hind leg or by the unprotected skin of the belly, and Service⁴ was much entertained by the encounters of wild ones, apparently all males. On 15th May he found a couple "snuffling" at each other, and they then began a monotonous "mill-wheel walk" with noses opposed. This circling continued for three-quarters of an hour by the watch, and after an absence of twenty minutes they were found sixty yards away, still rolling over and worrying each other as viciously as ever he had seen dogs fighting. Each had hold of the other by a fore paw, and was shaking it as a terrier does a rat, puffing and blowing with the exertion. Sometimes one was uppermost, sometimes

¹ *Irish Naturalist*, 1900, 50.

² *Zoologist*, 1854, 4477.

³ *Zoologist*, 1866, 59.

⁴ *Ann. Scott. Nat. Hist.*, 1901, 232-3.

the other. An incautious approach ended the fight, and they both scuttled into the bushes. They had been tearing at each other for eight minutes in his sight. Mr Moffat writes me in similar strain, but in his experience the combatants are so cautious as rarely to arrive at close quarters.

Amongst the ancients the Hedgehog was the subject of many superstitions and prejudices. Not the least curious is that repeated with variations by many authors, and of which Topsel's version runs:—"When he findeth apples or grapes on the earth, he rowleth himself upon them, untill he have filled all his prickles, and then carryeth them home to his den, never bearing above one in his mouth." To this some add the scaling of trees to secure their fruit, and A. R. Forbes quotes the Gaelic legend of the Hedgehog's hoard, or *cnuasachd na gràineag*, signifying that all things gathered in this world must be left at the grave, just as the Hedgehog has to leave its burden of crab-apples at the narrow entrance of its den. Another example of mediæval natural history may be found in a sixteenth-century treatise on riding,¹ by Thomas Blundevill, wherein it is gravely stated that "the shirle (*i.e.*, shrill) crye of a hedgeog strayt teyed by the foote under the Horses tayle, is a remedye of like force" for a jibbing horse.

An ancient belief which still survives in many country districts,² namely, that the Urchin sucks the cows during the night, seems at first sight to be in the highest degree improbable, and was accordingly scoffed at by Bell, who has been followed by most modern writers. But in favour of the prosecution it must in fairness be recorded that there exists a definite signed description of the finding of a hedgehog close to a milch goat in weather so warm as almost to preclude the suggestion of its having sought the goat for heat's sake.³ Again, the late J. H. Gurney (senior) printed the signed statement of a servant who found two hedge-

¹ *A New Book containing the Art of Riding*, published "at the sign of the Hedgehog, St Paul's Churchyard," ed. of 157—.

² *E.g.*, Nidderdale, Yorkshire (Storey), and stated by Spicer (*Zoologist*, 1858, 6058) to be very generally believed by the lower orders of the south of England.

³ A. C. Mackie, *Nature Notes*, 1901, 136.

hogs sucking a cow.¹ Major John Spicer,² an acute observer, commenting on the wide prevalence of the belief in milk-sucking, noticed the Hedgehog's power of stretching out its neck, its love of milk, and the cow's pleasure at being relieved of it, together with a supposed calf-like cry on the part of the Hedgehog, and confessed that he did not "see the great improbability of it." Lastly, Sir Harry Johnston points out that there is nothing improbable in a hedgehog, from merely seeking the neighbourhood of a cow on account of the insects which accompany her, being attracted to lick and finally to suck the nipples. But careful naturalists, remembering amongst other things, the small size of the Hedgehog's mouth, will probably await further evidence before they place the sucking of cows amongst the habitual accomplishments of the animal; and I am inclined to think that the story may be classed with the many other mythical narratives which make the work of the older naturalists more picturesque than trustworthy.

The crimes of the Hedgehog, supposed or real, have caused this poor animal to be the subject of an unrelenting persecution from time immemorial. It appears in old Churchwardens' Accounts³ amongst the list of outlaws for whose devoted heads a reward was paid. The price in Westmorland was twopence⁴ in the seventeenth century, but in Oxfordshire⁵ and Bedfordshire double that amount in the two following. The pursuit, now abandoned by the churchwardens, has been taken up by the gamekeepers, with the result that the animal's numbers in any one district depend chiefly on the success which attend its enemies' efforts to reduce them.

In its natural state the Hedgehog is, with exceptions to be noticed below, almost entirely nocturnal. Its gait is quick and shuffling, and it proceeds, as it were, by starts, not continu-

¹ On the authority of T. F. Buxton; see *Zoologist*, 1853, 4151-4152. Adams also writes me that he once received somewhat similar and unsolicited testimony from a country boy.

² *Loc. cit.*, 6057.

³ H. A. Macpherson; for Buckinghamshire, see Cocks, *Zoologist*, 1892, 63; for Bedfordshire, J. Steele-Elliott, *Journ. cit.*, 1906, 161-167, 253-265.

⁴ Fixed at that amount by Act of Parliament in 1564, 8 Elizabeth (c. 15).

⁵ *Fide* Cocks. Cf. also Rochdale, Lancashire, 1643—"3 hedge hodgs, 1s. od." (Stubbs, *Zoologist*, 380).

ing its course for any considerable distance at a time. Constant interruptions occur while the animal halts to smell and snuff, or root a hole amongst the leaves and grass, then as suddenly it jogs along on its quiet way again.¹ Its food is sought chiefly by the sense of scent, which is so keen that Mr William Evans remarks that it will follow up the tracks of a beetle with facility and speed. So engrossed is the animal in its business, that any one who remains moderately still may watch it at work from a distance of a few yards.² So fearless is it of the quiet proximity of men, that it has been known to lick an observer's boots,³ or to thrust its snout under the instep in search of food.⁴ But on any suspicious movement the hitherto vivacious Urchin becomes motionless, its head dropping between its fore paws preparatory to subsidence, if need be, into a ball of impenetrable bristles. At times hedgehogs, perhaps when unwell, appear abroad by day, but their diurnal movements frequently coincide with times when food is scarce, such as autumn frosts. The increased number of slugs and snails which come out when a good shower succeeds a summer drought are also no doubt the cause of diurnal appearances.⁵

Although at first sight a clumsy and feeble creature, the Hedgehog is in reality possessed of astonishing activity,⁶ even in spheres in which it would have been, perhaps, least expected, namely, as a runner, climber,⁷ and swimmer. It has no hesitation in ascending to a height, and, provided that the nature of an obstacle is such as to afford it a little assistance, as when the surface of a wall is rough, or there are rain-pipes,⁸ fruit trees,⁹ or creepers,¹⁰ it will readily make its escape even from enclosed gardens or yards. One which I placed in an enclosure fenced in by two sets of close-meshed netting worked its way

¹ See Rev. A. C. Smith, *Zoologist*, 1853, 4010.

² H. J. J. Brydges, *Zoologist*, 1847, 1768. Service has had eight in full view within twenty yards on a summer's evening.

³ Millais, i., 115-116.

⁴ *Fide* Moffat.

⁵ *Ibid.*

⁶ Despite its spines it can scratch its own back (Rev. C. A. Bury, *Zoologist*, 1844, 778).

⁷ Cocks also writes me that he has often been astonished at the powers of climbing exhibited by captives.

⁸ R. H. Scott, *Zoologist*, 1886, 242, from *Nature*.

⁹ O. Grabham, *Field*, 3rd December 1898, 897.

¹⁰ Mansel-Pleydell, *Journ. cit.*, 16th November 1895, 827.

in between the two and thus clambered out. It seems to have no fear of falling, and alights on its feet in leaping off a table to the ground, with the air and elasticity of an animal thoroughly accustomed to such performances.¹ It has even been observed to drop five feet down a bank into a river, across which it proceeded to swim.² As a swimmer its proficiency at least equals its needs, and it must be at times capable of considerable achievements in this direction.³ Mr Cocks once knew one to land at Great Marlow after a swim in the Thames, which must have extended, probably down stream, for some hundreds of yards. Mr Millais has drawn one in the water ;⁴ the animal is immersed deeply, with back, eyes, and snout just above the surface.

In the daytime the Hedgehog retires to a warm, soft nest of moss and leaves, where, rolling itself into a compact ball, it sleeps heavily and with much snoring until the approach of night summons it to the outer world. This nest is usually placed in some covered situation, as in the hollow of a tree decayed at the base, or amongst the naked roots from which the earth has been washed away, in holes of rocks, in a dry hedgerow, or under the brushwood in a coppice. The favourite materials are withered leaves, perhaps because they are effective in keeping out the wet. There is no definite arrangement of the nest, but the animal is well concealed by a coating of leaves, which, becoming perforated by its spines, often remain attached to it after it has left its bed.

The nest is never (in the wild state) encumbered by the stores which provident animals such as rodents lay up for their winter use. Instead, the Hedgehog trusts to hibernation to carry it through the lean months of the year, and then subsists on the thick masses of fat which by the onset of autumn have accumulated in its body.⁵ This hibernation, although well known to be extremely irregular in captive animals, had

¹ From greater heights it probably alights on its bristles—see above, p. 58, and Atkinson, *op. cit.* Moffat has sent me details of a third method of alighting ; he once saw one, before dropping from a height of not more than four feet, spread itself out into "an almost flat" shape, evidently with a view to break the fall.

² H. J. Charbonnier.

³ See Max Peacock, *Naturalist*, 1901, 44.

⁴ *The Mammals of Great Britain and Ireland*, vol. i., plate facing p. 112.

⁵ A male dissected by Robert Patterson on 15th September had the dorsal fat-layer fully a quarter of an inch thick ; see *Irish Naturalist*, 1901, 254. This fat is used by labourers as a salve for rheumatism (Jones, *Woodcraft*, 1910, 101).

never—in this country—been studied in detail until Mr Moffat¹ undertook the task at Ballyhyland, County Wexford, Ireland. His observations show that the animal is herein no less eccentric than in its appearance and general habits. Watching its haunts regularly throughout a single winter from 26th October to the end of February, he found it abroad on fifteen nights in November, nine in December, four in January, but not at all in February. The hibernation, in so far as it showed a progressive decrease up to February, resembles that of the *Pipistrelle*, but beyond that point there was no coincidence. The winter appearances of the bats depended entirely on temperature, and they were always active when the weather was mild. On the contrary, there was no evidence that warmth had any effect in waking up the Hedgehog; indeed, it was almost invariably on the cold nights that it was encountered, as if its winter activity was independent of weather. It is noteworthy that, although in December and January bats were observed on nineteen and hedgehogs on thirteen occasions, yet there were only two nights in December and not one in January on which both were seen abroad simultaneously.

Mr Moffat's remarks can only be regarded as conclusive for a single winter and a particular locality. It is clear that the hibernatory habits of an animal having a wide geographical range must vary considerably, and that for the hedgehogs there will be found many variations between the routine of those southern forms which, according to Blanford, never hibernate, and the more northern, the hibernation of which in Germany is described by Blasius as commencing, apparently irrespective of date, only when the temperature drops to 38.75° or 36.5° F., and terminating in March when the temperature of mid-day rises to 54.5° or 59° F.

Evidently extreme eccentricity and uncertainty are the main characteristics of the hibernation of the animal in Ireland, and on this point it is well to remember that Mr Moffat's notes are supported by the recorded observations of other naturalists, who have remarked on its discontinuity² and upon the un-

¹ *Irish Naturalist*, 1904, 81-87. Moffat has also sent me some MS. notes supplementing his paper.

² Grabham in Yorkshire, *Zoologist*, 1896, 76.

HISTORY OF BRITISH BIRDS—*continued.*

histories of very many others, which were formerly little known, have been fully elucidated, while, speaking generally, an immense increase in our knowledge on such important subjects as Migration, Distribution, Habits, Nidification, Plumages, has accrued: And lastly, a new and important branch of study has been instituted—namely, the recognition of the various Racial Forms or Sub-species exhibited by certain birds in the British Islands, on the Continent, and elsewhere.

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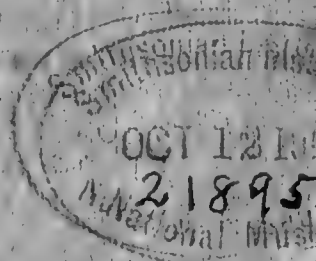
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A NEW AND REVISED EDITION OF
YARRELL, NEWTON, AND SAUNDERS'

HISTORY OF BRITISH BIRDS

EDITED BY

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*ILLUSTRATED BY ORIGINAL COLOURED PLATES OF EACH SPECIES
SPECIALLY EXECUTED BY*

MISS LILIAN MEDLAND

THE publication of Yarrell's "History of British Birds" was commenced in 1837 and completed in 1843. Its outstanding merits were at once recognised, and a Second Edition was called for in 1845, followed by a third in 1856.

From the issue of the Original Edition down to the present day, Yarrell's "History of British Birds" has generally and deservedly been regarded as the standard authority on British ornithology.

In the year 1871 a Fourth Edition was begun, under the masterly editorship of Professor Newton—the greatest British ornithologist of all time. Unfortunately Professor Newton's official engagements at the University of Cambridge only allowed him to complete the first two volumes; and in 1882 Mr Howard Saunders was selected to edit the remaining volumes, a task which he successfully accomplished to the entire satisfaction of ornithologists in 1885.

The many excellences of this last edition advanced the work more than ever in the public and in scientific favour. To its stimulating influence is to be mainly attributed the marvellous and unprecedented activity which has resulted in those extraordinary advances made in all branches of British ornithology during recent years—advances which have rendered it essential that a new work based upon this classical and comprehensive foundation should be issued.

During the period alluded to, a considerable number of new and interesting species have been added to our avifauna. The

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The English local names have been revised in part by Mr W. W. Skeat, M.A. (assisted by Professor W. W. Skeat), and in part by Mr C. M. Drennan, M.A. Lond., late Scholar Emm. Coll. Camb.; the Celtic and Gaelic names by Dr E. S. Quiggin, M.A., Ph.D., Fellow and Lecturer in Modern Languages and Celtic of Gonville and Caius College, Cambridge; while a list of Scottish Gaelic names have been supplied by Mr C. H. Alston. Valuable assistance has been rendered by Mr M. C. A. Hinton regarding extinct Mammals.

ILLUSTRATIONS

FULL-PAGE (*Coloured and Black and White*).

House Mouse. (*Coloured*.)

The Hedgehog.

The Hedgehog—(1) Left Hand; (2) Left Foot; (3) Left Ear;
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The Shrew—Left Ears of (1) Common; (2) Pygmy; (3) Water.

The Shrew—Tails of (1) Lesser; (2) Common; (3) Water.

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Mandibular Articulation of *Soricinæ*. (Drawn by M. C. A. Hinton.)

Side View of Teeth of (1) *Sorex araneus*; (2) *Sorex minutus*;
(3) *Neomys fodiens*.



expected appearance of the animal in times of frost and snow.¹ They thus confirm Spallanzani's Italian experiment, and in Dumfriesshire Service has encountered individuals perambulating upon an inch of snow on 22nd November and in mild weather on 3rd January.² But, on the other hand, Dr Laver informs me that he is sure that in Essex some individuals sleep right through the winter, and a Manx captive in the possession of Mr P. M. C. Kermode slept from Christmas Eve to 19th April following. It is evident that the relative hiemal activity of the animal should be studied from north to south of the country.

After a period of gestation³ which has been variously computed at from about four⁴ to seven weeks,⁵ the female produces her young at a date which may be in or about April, or between mid-August and the beginning of October.⁶ The number is generally four or five, but varies in exceptional instances between two⁷ and eight⁸ or nine⁹; litters of seven have been recorded by Mr Harting (twice)¹⁰ and Mr F. H. Parrott.¹¹ The later births are the second litters of the season, and are always separated from those of spring by the interval mentioned above. The newly born young are blind, and the future spines are hardly perceptible; at first these are white, soft, and flexible, but, hardening in the course of a few days, they become first brown, later annulated. The ears, as remarked by Gilbert White,¹²

¹ C. A. Witchell, *Journ. cit.*, 1896, 98; Gordon Dalgliesh, *Field*, 19th November 1904, 908; and *Zoologist*, 1906, 170.

² *Ann. Scott. Nat. Hist.*, 1901, 79.

³ The pairing of this animal, either "standing upright because of their spines" (Aristotle, *De Generatione Animalium*, Arthur Platt's ed., 1910, i., 5, 717^b, 30), "belly to belly" (Aristotle, *Historia Animalium*, D'A. W. Thompson's ed., 1910, v., 2, 540^a, 3), or ventral as in porcupines (Sir Thomas Browne, 311), engaged the curious attention of many ancient and mediæval writers. It has recently been described by R. Collett, who states that the male may follow the female for several hours, after which the pair wander round each other in a small circle till at last the pairing takes place, the female lying on her back. The latter fact was also given by Lilljeborg.

⁴ Flower and Lydekker; E. L. Trouessart, *Histoire naturelle de la France*, 1884, 75.

⁵ This figure is probably correct, since it was given by Lilljeborg, a very careful writer.

⁶ 23rd September for Ireland, *vide* Patterson, *Irish Naturalist*, 1901, 254; 28th September (recently born), Girvan, Ayrshire, Scotland, James Lumsden, *Proc. Nat. Hist. Soc.* (Glasgow), iii., 187, 27th March 1877; H. E. Forrest observed half-grown young near Shrewsbury in the last week of November 1910 (*in lit.*).

⁷ Bell; also Cocks.

⁸ Blasius.

⁹ Collett.

¹⁰ *Vermin of the Farm*, 1892, reprint, 34.

¹¹ *Zoologist*, 1887, 424.

¹² Letter xxvii. to Thomas Pennant, 22nd February 1770.

at first hang downwards, and the sucklings lack the power of rolling themselves into a ball. But they leave the nest in about a month, and grow so rapidly that those of the spring litters are to all appearances fully grown the same season; those of the autumn remain with their mother until they nearly equal her in size, and they, perhaps, share with her their winter retreat.¹ In an interesting article² Major Spicer has described the manner of suckling. The mother "lay at full length on her side, or rather nearly on her back, for their convenience, just like an old sow with pigs in a sty, and the young ones worked away at her paps, smacking their lips, and making almost as much noise about it as young pigs would do: their cry when not suckling is a sort of continuous short whistle or chirp, like the cry of a bullfinch, and more like a small bird than an animal."³ The same mother when confined in a garden with her young ones, which were about the size of small oranges, scratched a hole under the fence and removed them one by one. She carried them by the back of their necks in her mouth, and was strong enough to trot with her burdens raised quite off the ground.

Few people seem to have heard a hedgehog utter sounds more distinctive than grunts, snorts, snores, or chuckles⁴ of satisfaction. Yet the animal makes a loud noise when in fear or distress, a kind of wail, recalling the cry of a hare when in trouble.⁵

This is probably the same as the shrill cry mentioned by Blundevill in the sixteenth century,⁶ and it is variously described as a "whining sound,"⁷ or as a long succession of screeches or screams.⁸ It was mentioned by Shakespeare in the famous lines⁹—

"Thrice the brinded cat hath mew'd.
Thrice; and once the hedgepig whin'd,"

and it probably corresponds to the loud, cat-like squeals of the Eared Hedgehog¹⁰ described by Miss Bate.

¹ Adams in MS., but hibernation is normally solitary.

² *Zoologist*, 1858, 6055-6056.

³ Edward Jesse, ed. *Selborne*, 1854, 109, wrote of the young that "the incessant cry they make for their mother when hungry leads to their discovery."

⁴ Sir R. Payne-Gallwey, *Field*, 26th November 1898, 858.

⁵ See above, p. 61, when seized by a badger; also Jones, *Woodcraft*, 1910, 15.

⁶ See above, p. 68.

⁷ Editor of *Field*, 26th August 1899, 294.

⁸ *E.g.*, by Moffat (*in lit.*).

⁹ *Macbeth*, Act iv., sc. 1, line 2.

¹⁰ *Hemiechinus auritus* (Gmelin).

In some parts of England¹ country boys have a way of making the poor brutes scream or wail by drawing a small piece of stick to and fro across one of the hamstrings. Mr Jones, who describes this proceeding,² thinks that it "really tickles the hedgehog, and makes him laugh in his own peculiar way."

Another cry, habitually uttered by animals wandering about at night, has been likened by Major Spicer to the voice of a calf, and is probably the same note which an anonymous writer described as a kind of "quack, quack, quack."³ It was compared by Witchell⁴ rather to a grunt than a quack, and by other writers to a "quack" or "craque," closely resembling the sound made if the thumb nail be drawn slowly along the larger teeth of an ordinary comb.

Hedgehogs are easily rendered familiar, and will soon partake without fear of the food of other domestic pets, eating at the same time with them and from the same dish. They do not, however, seem to be long-lived.⁵ They will allow their faces to be rubbed or keep their bristles smooth to be stroked. They have been harnessed to a small toy cart,⁶ and have learnt the meaning of a dinner whistle, running or gambolling up to the call, but retiring with a different air when satisfied. William Thompson of Belfast⁷ mentions the fact that they will drink beer to intoxication, and Mr Cocks once tamed a newly caught individual by drenching it with beer as it lay rolled up, and stroking it whenever it uncurled. On recovering sobriety, it remained for the rest of its life perfectly tame.

Hedgehogs must have been tamed from time immemorial, since Aristotle⁸ incidentally mentions that those that are kept in domestication shift from one wall to the other, according to the direction of the wind.

¹ As in Essex, *fide* Laver (*in lit.*).

² *Op. cit.*

³ *Field*, 26th August 1899, 294.

⁴ *Field*, 2nd September 1899, 400.

⁵ Captain W. Buckley, however, informed Forrest that he believes they reach an age of at least twenty years.

⁶ M. J. Simpson, *Irish Naturalist*, 1895, 136.

⁷ Quoting from R. Ball, in *The Irish Penny Journal*, 1840-41.

⁸ *Historia Animalium*, ed. cit., ix., 6, 612^b.

SORICIDÆ.

SHREWS.

Sub-Family *Soricinæ*.

RED-TOOTHED SHREWS.

SHREWS in outward appearance bear a strong resemblance to mice, but their projecting, proboscis-like snout, minute eyes, and comparatively small front teeth or incisors, are distinctive. The following **key** will be found helpful :—

I. EXTERNAL CHARACTERS:—

- | | | |
|---|---|--|
| 1. Colour above not darker than "clove brown";
feet and tail not fringed or keeled; hind
foot not exceeding 14 mm. | } | <i>SOREX</i> . . . p. 77 |
| (1) Size larger, hind foot 12 to (rarely) 14
mm.; length of head and body to that
of tail, nearly as 7 to 3.5 (2 to 1) . . | } | <i>S. araneus cas-</i>
<i>taneus</i> } p. 82 |
| (2) Size smaller, hind foot 10 to 11 mm.;
head and body to tail, about as 6 to 4
(3 to 2) | } | <i>S. minutus</i> . . . p. 109 |
| 2. Colour above blackish slate or slate black; feet
fringed and tail keeled with strong (usually
white) hairs; hind foot averaging 17 mm. . | } | <i>NEOMYS</i>
<i>fodiens bicolor</i> } p. 124 |

II. SKULLS AND TEETH:—

- | | | |
|--|---|--|
| 1. Teeth 32; large upper incisors about equally
bicuspid; lower with three basal knobs . . | } | <i>SOREX</i> . . . p. 77 |
| (1) Skull larger, greatest length about
19 mm.; posterior lobe of anterior
upper incisor with basal length about
equal to that of the anterior lobe . . | } | <i>S. araneus cas-</i>
<i>taneus</i> } p. 82 |
| (2) Skull smaller, greatest length about
16 mm.; posterior lobe of anterior
upper incisor with basal length about
half that of the anterior lobe . . . | } | <i>S. minutus</i> . . . p. 109 |
| 2. Teeth 30; large upper incisors unequally
bicuspid; lower with one basal knob . . . | } | <i>NEOMYS</i>
<i>fodiens bicolor</i> } p. 124 |

GENUS SOREX.

1758. SOREX, Carolus Linnæus, *Systema Naturæ*, x., 53 ; xii., 73, 1766 ; based on *S. araneus*—type ; see Thomas, *Proc. Zool. Soc.* (London), 1911, 143, published March 1911—and two other species ; not *Sorex* of Duvernoy, 1835 = CROCIDURA.
1829. OXYRHIN, Jakob Kaup, *System der Europäischen Thierwelt*, i., 120 ; based on the indeterminable *Sorex constrictus* of Hermann in Zimmermann, *Geographische Geschichte des Menschen*, etc., 1780, sp. 313 ; and *Sorex tetragonurus* of Hermann in Zimmermann = *S. araneus tetragonurus* ; both described from Strassburg, Germany.
1835. HYDROSOREX (part), G. L. Duvernoy, *Mém. Soc. Mus. d'Hist. Nat.* (Strassburg), 17th June and 2nd December 1834, 17 and 33, pl. i., figs. 2 and 2b, pl. ii., figs. 4 and 5 ; based on *Sorex fodiens*, description + *S. araneus*, figure of skull of ; and *S. tetragonurus* = *S. araneus tetragonurus*.
1838. AMPHISOREX, G. L. Duvernoy, *L'Institut* (Paris), Ann. vi., No. 226, 112, April, and *Mém. Soc. Mus. d'Hist. Nat.* (Strassburg), Suppl., 4, 30th January 1838 ; based on *S. tetragonurus* of Hermann, and other species ; preoccupied by *Amphisorex* of Duvernoy, *Mém. cit.*, 17th June and 2nd December 1834 (published 1835), 23, pl. i., fig. 1b, pl. ii., fig. 6 = NEOMYS of Kaup, 1829.
1838. CORSIRA, J. E. Gray, *Proc. Zool. Soc.* (London), 1837, 123, published 14th June 1838 ; based on *S. vulgaris* of Linnæus = *S. araneus*.
1842. OTISOREX, J. E. de Kay, *Zoology of New York*, i., *Mammals*, 22-23, pl. v., fig. 1 ; based on *O. platyrhinus* of de Kay = *S. personatus* of Geoffroy and *O. longirostris* of de Kay = *S. longirostris* of Bachman.
1890. HOMALURUS, E. Schultz, *Schriften des Naturwissenschaftlichen Vereins des Harzes* (Wernigerode), v., 28 ; based on *S. alpinus* of Schinz ; ? preoccupied by HOMALURA of Meigen, 1826, a genus of Diptera.

Synonymy:—There is in this case fortunately no difference of opinion as to the nomenclature.

The genus *Sorex*, as at present restricted, includes a number of mouse-like forms, all characterised by small size and elongated bodies, and inhabitants of the northern regions of the Old and New Worlds. They are thickly coated with hair, which is changed by a **moult** in spring and autumn. The long and pointed muzzle, which projects considerably in front of the lower jaw, carries the prominent nostrils at its extremity.

The eye is minute, and the sight is probably poor. The ear, although without prominent external parts, is well developed, and the opening is provided with three valves (Plate VI., Figs. 1 and 2), a small one in the position of the tragus, a larger antitragial, and, above the latter, a third, of size similar to the last, situated somewhat in the position of the human antihelix ; the two latter carry tufts of hair. Both hand and foot are simple, formed for running, and each has five well-developed, clawed digits, of which the central is the longest. The tail is long and

moderately hairy (Plate VII., Figs. 1 and 2). The generative organs, which are much enlarged during the breeding season, open separately from the anus; the vagina is imperforate in the young female; the penis is cylindrical or tapering.

There is no cæcum; the stomach is elongated pylorically, and is not globular as in *Neomys*, to be described below (see Jenyns, *Ann. and Mag. Nat. Hist.*, June 1841, 267).

The **mammæ**, placed inguinally, are normally arranged as three pairs.

There is on each side of the body, at a point situated at about one-third of the distance from the elbow to the knee, a lateral gland (see Linde, Gegenbaur's *Morphologische's Jahrbuch*, xxxvi., 465, 1907), covered by two rows of coarse hairs. From this exudes a secretion to which shrews owe their peculiarly **unpleasant odour**; the gland is especially prominent during the breeding season, at which time also there is an enormous development of the generative organs.

In the **skeleton** there is no pubic symphysis, and the tibia and fibula are united.

The long and narrow **skull** tapers markedly to the snout, and is without zygomatic arch, post-orbital process, or tympanic bulla, the tympanum being ring-like.

Hinton points out that the mandibular condyle affords good generic characters, which are very useful in determining jaws of fossil shrews or those from owls' pellets. Shrews are peculiar among mammals in having two articular facets upon the condyle (Fig. 23, Nos. 1 and 3), an upper (*s*) and a lower one (*i*), widely separated from each other by a non-articular tract of bone. In *Neomys* the lower facet (Fig. 23, Nos. 2 and 4), *i*, is greatly prolonged towards the inner or lingual side, and the non-articular part of the condyle, as seen from behind, is much constricted. In *Sorex* the lower facet is without the lingual prolongation, and the non-articular part is not constricted.

The **dental formula** is probably—

$$i \frac{4-4}{2-2}, \quad c \frac{1-1}{0-0}, \quad pm \frac{2-2}{1-1}, \quad m \frac{3-3}{3-3} = 32.$$

The **dentition** (Fig. 24, Nos. 1 and 2, p. 90) is highly characteristic, but the homologies of the five small teeth

lying between the large central upper incisors and the last premolar are somewhat obscure, since the premaxillo-maxillary suture disappears very early in life. If Brandt be correct in his assertion (see *Bull. Soc. Imp. des Nats. de Moscou*, xli., iii., 76-95, 1868; xliii., ii., 1-40, 1871; Dobson, *Proc. Zool. Soc.* (London), 1890, 49-51) that in the type of the genus this suture lies between the fourth and fifth teeth, then the first

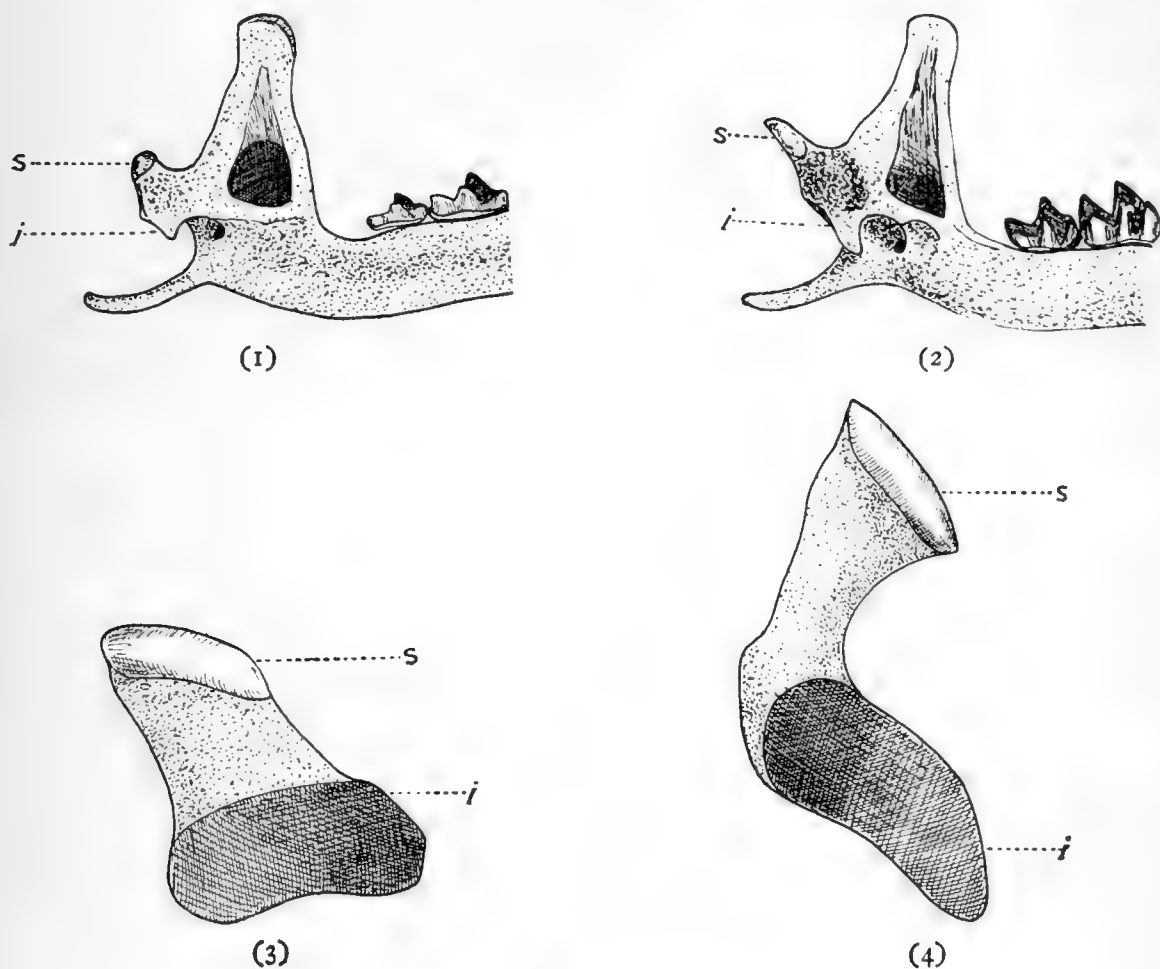


FIG. 23.—MANDIBULAR ARTICULATION OF *Soricinae*. (Drawn by M. C. A. Hinton.)

Inner view of posterior part of left ramus of (1) *Sorex araneus*, and (2) *Neomys fodiens*. In (3) and (4) the respective condyles are shown in posterior view, much enlarged, *s* and *i* being the superior and inferior articulating surfaces.

four must be reckoned as incisors—a number unique amongst the higher mammals. On this notation the fifth tooth is a canine; then follow two premolars, the first minute, the second large, and three molars; but it is simpler to style all between the central incisors and the molariform teeth as unicuspid. The notation of the lower teeth is that of Dobson, and is based on his having found a minute seventh tooth, thought to be a

canine, lying between the second and third of the series in *Myosurus varius* (*Journal of Anatomy and Physiology*, 1886, 359).

The conspicuous front tooth of the upper jaw (central incisor) is stout and hook-like, and is provided posteriorly with a large basal cusp or knob; then follow the five unicuspid formed as compressed triangles. The upper molars have cusps exhibiting a W-shaped pattern. In the lower jaw the first incisor projects horizontally forwards, and has on its upper surface three distinct lobes behind the prominent cutting edge; the smallest tooth in the set follows next to it, the premolar being slightly larger.

The summits of the teeth are coloured reddish-brown.

The teeth are well developed and the cranial sutures ankylosed—in most mammals a true test of maturity—very early in life. The last to close is the basi-occipital suture, which is accordingly the best guide to the age of a specimen.

Shrews make their first appearance in the Oligocene of North America and Europe (Osborn). The genus *Sorex*, although, if correctly identified, it is coeval with the sub-family in Europe, is unknown in North America before the Pleistocene (Osborn), and in Britain before the late Pliocene.

As the result of a recent examination of **British fossil shrews**, Hinton has found two extinct species in the late pliocene Forest-Bed. One of these, which he names *S. savinii*, is distinguished as the largest British species hitherto discovered; the other, which he calls *S. runtonensis*, is a form not much larger than *S. minutus*. A third extinct species is known to occur in the pleistocene (Middle Terrace), brickearth of Gray's, Essex, and was almost of the same size as *S. araneus*; and still another form, which Hinton names *S. kennardi*, has been found recently in a later pleistocene (Third Terrace) deposit at Ponder's End, Middlesex. The latter was intermediate in size between *S. araneus* and *S. minutus*, and its skull and jaws present some features which suggest affinity both with the latter species and with *S. alpinus*. Hinton's complete descriptions will appear in the *Geological Magazine*.

The **most nearly allied genera** are *Soriculus* of the Oriental region, without separate orifices for anus and generative organs;

the American *Notiosorex*, with only twenty-eight teeth; the short-tailed *Blarina*, also American; and the familiar *Neomys*, or water shrews. These constitute the sub-family *Soricinæ*, or red-toothed shrews, which are thus readily distinguished from the *Crocidurinæ*, or white-toothed shrews, a sub-family with two European genera, *Pachyura* and *Crocidura*. The latter is numerous in species, and represented on the continental shores of the English Channel and even in the Channel Islands (Sinel). It was a *Crocidura* that was mummified by the ancient Egyptians.

The two **British species** of *Sorex* resemble each other so closely that they are often confounded. They are extremely active, quarrelsome, and voracious animals, very widely distributed all over the country, and the larger of them at least in great abundance. They spend their time in an almost incessant pursuit of such living things, chiefly invertebrates, but occasionally vertebrates—even their own species—as they can overpower; and their unreasoning and indiscriminating ferocity is indicative of low brain power. They may consume vegetable matter in times of scarcity, but there is little evidence of this for wild individuals in Britain. The breeding season lasts for nine months of the year, and they produce as many as eight or ten young at a time. These, which are naked and helpless at birth, are deposited in a warm nest, where they grow rapidly. Although, owing to their enormous appetite, shrews soon become reconciled to captivity, they usually die after a few weeks; indeed, so many dead carcasses are found lying about in open places, especially towards the end of summer, that it seems probable that the span of their natural existence is brief, perhaps not exceeding a year or thereabouts.

They swim well and can climb when occasion arises, but probably dig little, preferring to occupy natural crevices or the runs of small rodents. They do not hibernate.

Shrews are of delicate constitution, and readily succumb to injuries.

They possess an unpleasant **odour**, so that many carnivorous animals will not readily eat them, and, owing to the character of the contents of their intestines, when killed they undergo a rapid putrefaction.

A third European species, *S. alpinus* of Schinz, inhabits the Pyrenees, Alps, Harz Mountains, Riesengebirge, and Carpathians; it is a dark, slate-coloured shrew, about the size of *S. araneus*, but with a long tail of about the same length as the head and body, and distinctive skull and teeth.

THE COMMON SHREW.

SOREX ARANEUS, Linnæus.

SOREX ARANEUS CASTANEUS (Jenyns).

1667. *MUS ARANEUS*, the *Erdshrew* or *Field Mouse*, Christopher Merrett, *Pinax*, 167
1758. *SOREX ARANEUS*, Carolus Linnæus, *Systema Naturæ*, x., 53; xii., 74, 1766; described from Upsala, Sweden; Bingley; Donovan; Fleming; Jenyns; Bell (ed. 1); MacGillivray; Thomas, *Zoologist*, 1895, 63; Millais; Barrett-Hamilton, *Ann. and Mag. Nat. Hist.*, May 1905, 506; Trouessart (1910); Collett; not *S. araneus* of Schreber and others = Hermann's *Sorex* (now *Crocidura*) *russula*.
1764. *SOREX VULGARIS*, Carolus Linnæus, *Museum Regis Adolphi*, &c., 10; renaming *S. araneus*; Nathusius, Wiegmann's *Archiv. für Naturgeschichte*, 1838, i., 45; Owen; Blasius; Fatio; Bell (ed. 2); Woodward and Sherborn; Flower and Lydekker; Lydekker; Johnston; Winge.
1780. *SOREX TETRAGONURUS*, Johannes Hermann in E. A. W. Zimmermann's *Geographische Geschichte des Menschen*, &c., ii., sp. 312, 383; described from Strassburg, S. Germany; Schreber, *Die Säugethiere*, Supplement, iii., pl. clix*b*, 1781; Hermann, *Tabula Affinitatum Animalium*, &c., 1783, 79, footnote; MacGillivray (appendix); Clermont; Alston, *Fauna of Scotland*, 1880, 9.
1792. *SOREX QUADRICAUDATUS*, Robert Kerr, *Animal Kingdom*, 208; renaming *S. tetragonurus* of Hermann.
1800. *SOREX ARANEUS ALBUS*, J. M. Bechstein, Thomas Pennant's *Allgemeine Uebersicht der vierfüssigen Thiere*, ii., 722; described from a white variety.
1801. *SOREX CUNICULARIUS*, J. M. Bechstein, *Gemeinnützige Naturgeschichte Deutschlands*, ed. 2, i., 879; described from Thuringia, Germany.
1828. *SOREX CORONATUS*, P. A. Millet, *Faune de Maine et Loire*, i., 18; described from Blou, Maine et Loire, France.
1828. *SOREX PERSONATUS*, P. A. Millet, *Op. cit.*, i., 18, footnote; a rejected MS. name for *S. coronatus*; not *S. personatus* of I. Geoffroy, 1827.
1832. *SOREX CONCINNUS*, J. Wagler, Oken's *Isis* (Jena), 54 and 275; described from Bavaria.
1832. *SOREX RHINOLOPHUS*, J. Wagler, *Journ. cit.*, 54; described from Bavaria.
1832. *SOREX MELANODON*, J. Wagler, *Journ. cit.*, 54; described from Bavaria.
1835. *HYDROSOREX TETRAGONURUS*, G. L. Duvernoy, *Mém. Soc. Mus. d'Hist. Nat.* (Strassburg), 17th June and 2nd December 1834, 19 and 33, pl. i., figs. 2 and 2*b*, pl. ii., fig. v.
1838. *CORSIRA VULGARIS*, J. E. Gray, *Proc. Zool. Soc.* (London), 1837, 124, published 14th June 1838.
1838. *SOREX TETRAGONURUS*, var. β , *S. CASTANEUS*, Leonard Jenyns, *Ann. Nat. Hist.*, i., 424, August; ii., 43, 1839; vii., 266-267, 1841; see also *Mag. Zool. and Bot.*, ii., 39, 1838; described from Burwell Fen, Cambridgeshire, England.

1838. AMPHISOREX TETRAGONURUS, G. L. Duvernoy, *Mém. Soc. Mus. d'Hist. Nat.* (Strassburg), Suppl., 4, 30th January; and *L'Institut* (Paris), *Ann.*, vi., No. 226, 112, April.
1839. SOREX LABIOSUS, Leonard Jenyns, *Ann. Nat. Hist.*, ii., 326, January; described from Frankfort-on-Maine, Germany.
1839. SOREX MACROTRICHUS, E. de Selys-Longchamps, *Études de Micrommalogie*, 20; from Mehli's MSS.; ? adult in winter.
1846. SOREX FODIENS and SOREX REMIFER, Sir Richard Owen, *British Fossil Mammals*, &c., 28, in error.
1855. AMPHISOREX VULGARIS, C. G. Giebel, *Säugethiere*, 900.
1868. SOREX VULGARIS, PALLIDUS, L. J. Fitzinger, *Sitzungsberichte der Kaiserlichen Akad. der Wissenschaften* (Vienna), lvii. (1), 488; naming a pale variety without locality from Bonaparte, *Fauna Italica*, pl. xviii.
1869. SOREX VULGARIS, VARIETAS NUDA and VARIETAS NIGRA, Victor Fatio, *Vertébrés de la Suisse*, i., 127; described from the Bernese Oberland and from Lucerne, Switzerland, and based on worn and winter specimens respectively of *S. a. tetragonurus*; see Mottaz, *Bull. Soc. Zool.* (Geneva), i., 9, 15th November 1908, 153-154.
1870. SOREX INTERMEDIUS (part), E. Cornalia, *Catalogo descrittivo dei Mammiferi osservati fino ad ora in Italia*, 27 (not seen); described from hills of Brianza, Italy; although quoted under *S. alpinus* by authors, is based upon a made-up specimen of *Sorex* and *Neomys*; see Sordelli, *Atti della Soc. Ital. di Sci. Nat.*, xxxviii., 362-365, 17th December 1899.
1885. CROSSOPUS REMIFER, R. Lydekker, *Catalogue of Fossil Mammalia*, i., 17, in error.
1890. HOMALURUS VULGARIS, E. Schultz, *Schriften der Naturwissenschaftlichen Vereins des Harzes* (Wernigerode), v., 28.
1900. SOREX VULGARIS, "var. vel. subsp. MOLLIS," Victor Fatio, *Rev. Suisse de Zool.*, 8, 471; renaming his var. *nigra* of 1869; see Mottaz, *Bull. Soc. Zool.* (Geneva), i., 9, 15th November 1908, 154.
1901. SOREX ARANEUS ALTICOLA, G. S. Miller, junior, *Proc. Biol. Soc.* (Washington), xiv., 43, 25th April; described from Meiringen, Switzerland = *S. araneus nuda* and *S. a. nigra* of Fatio; see Mottaz, *Mém. de la Soc. Zool. de France*, xx., 24, 26, 1907.
1905. SOREX VULGARIS CRASSICAUDATUS, Victor Fatio, *Archives des Sci. Phys. et nat.* (Geneva), xix., 201, 15th February; described from Zermatt, Switzerland = *S. araneus alticola* of Miller; see Mottaz, *Mém. de la Soc. Zool. de France*, xx., 24, 1907, and *Bull. Soc. Zool.* (Geneva), i., 9, 15th November 1908, 166.
1905. CROSSOPUS ou SOREX IGNOTUS, *Auct. and Journ. cit.*, 201-202; described from Switzerland and based on *Neomys fodiens* (skull) + *Sorex* (jaw); see Mottaz, *Bull. Soc. Zool.* (Geneva), i., 9, 15th November 1908, 167.

La Musaraigne vulgaire of the French: *die Waldspitzmaus* of the Germans.

As the **synonymy** of the species *S. araneus* has not been recently published in detail, it seems useful to print it as above, and not to be content with the names which have been applied only to the British subspecies. There are omitted, therefore, only certain recent sub-specific names, which have neither been applied to the British Common Shrew nor affect the treatment of the species as a whole. These will

be found under heading of Geographical Variation. *Castaneus* was undoubtedly the first name bestowed definitely by its describer on a British Common Shrew, and is therefore applicable to the native subspecies.

The majority of the technical names are based upon differences due either to age, season, or individual variation. At least two, viz., *tetragonurus* and *castaneus*, have reference to sub-specific differences; not, however, those observed by the original describers. Two, *fodiens* and *remifer*, have been transferred in error from another species. Although *araneus* has undoubted precedence by priority for the species as a whole, there has been in the past much confusion and misuse in its application, as well as in that of *vulgaris* and *tetragonurus*. This arose from the fact that, whereas in Skandinavia, as in England, there are but two species of shrews, both red-toothed or true *Sorices*, on the Continent of Europe generally there occur also the white-toothed shrews of the genus *Crocidura*. To one of these, *C. russula* (Hermann), being the commonest species of middle Europe, the name *araneus* was at first somewhat naturally applied. When the identity of Linnæus's *araneus* was discovered, some naturalists substituted for it the name *vulgaris*, which, however, is antedated by *araneus*. Others, amongst them MacGillivray and Alston, used the next available synonym, *tetragonurus*, but none of them ventured to alter the name of the *Crocidura*. This is, however, a case where, as Thomas has shown, the rules of priority admit of no doubt, and accordingly they are followed here.

Jenyns in his *Manual* was the first to doubt the identity of the animals styled by British and continental writers *araneus*, a suspicion which developed into conviction after he had read Duvernoy's paper of 1838. In that year Jenyns published an excellent essay, wherein, besides minutely describing the dentition of the British Common Shrew, he suggested the identity of British and Linnean *araneus* with Hermann's *tetragonurus* (see *Mag. Zool. and Bot.*, 1838, ii., 24-42; *Ann. Nat. Hist.*, August 1838, 422-427; September 1838, 43; and 1841, 263-268).

Terminology:—In the works of some writers shrews are known as shrew-mice, but the Anglo-Saxon forerunner of the word was used only as a substantive. Later, in consequence of the mischievous character attributed to the animal, the word "shrew" became an adjective, having the meaning "biting" or "noxious." Since the term "shrew-mouse" suggests a relationship which does not exist, its retention seems to be undesirable.

The older form *schrewe* came from the Anglo-Saxon *scrēawa* = a shrew-mouse, as explained in Wright's *Anglo-Saxon and Old English Vocabularies*, Wülcker's (2nd) ed., 1884, col. 122, line 20:—"Mus araneus, *scrēawa*." To the Latin *araneus*, which means "poisonous as a spider,"

may be traced "ranny," a word used by Sir Thomas Browne and still surviving in country districts, through an old French form *araigne* = a spider, as the old French ending *-gne* corresponds regularly to the English *-my*. In Somner's *Anglo-Saxon Dictionary* (1659), *scrēawa* is explained as "a shrew-mouse, which by biting cattle so envenoms them that they die." This was a belief of ancient date (see below, p. 100).

The Old Norse form of shrew is represented by *skrew* (or *screw*), and *skrow*, as in Scotland, Devon, Cornwall, and Ireland (*Dial. Dict.*).

Local names (non-Celtic):—*Blind mouse* of Cumberland and North Lincoln. *Harvest-mouse*, *harvest-shrew*, *harvest-shrow*, with their countless corruptions, producing *arti-shrew*, *harti-shrew*, *hardy-shrew*, *hardi-straw*, *harvest-trow*, *harvest-row*, *hardy-mouse*, and others, are very widely spread (see *Dial. Dict.*). Of these, some are old forms, as shown by the passage "In Italy the hardy shrews are venomous in their biting," found in Holland's translation of Pliny (b. viii., c. 58, 1601). This ancient superstition has helped the form *harvest-trow*, since "trow" or "troll" is a malicious elf or goblin; and the name may easily be transferred to true mice, as when Jefferies wrote:—"The nests of the harvest-trow—a still smaller mouse, seldom seen except in summer" (*Wild Life in a Southern County*, 1879, 186). The extreme corruptions are hardly recognisable, and have received other interpretations; thus, *ard-shrew*, through *erd-shrew*, has been connected with *earth-shrew*, while *nossro* (n-ossro, *Dial. Dict.*) has been translated as *nose-shrew*, and has many variants, as *nurserow* and *nostril*. *Over-runner* of Wiltshire (Harting, *Vermin of the Farm*, 22). *Pig-mouse* of Surrey (Dalglish, *Zoologist*, 1906, 274) and Northampton (Adams, MS.). *Ranny*, explained above, of Scotland and many parts of England (see *Dial. Dict.*). *Shear- or sheer-mouse*, *sheery- or sherry-mouse*, *shirrow*, *shrove-mouse* (as in Bellamy), *shrow-crop*, *straw-mouse*, and many others of various localities, of which the first four may mean "biting" or "cutting," but are probably mere corruptions or mutilations of shrew; the last but one explains the term "shrow-cropped," applied in Devon to an animal supposed to have been paralysed by a shrew creeping over its back.

(Celtic):—Irish — *luch féir* (=grass-mouse). Scottish Gaelic—*Beathachan* (*Beothachan*)-*feoir* = "grass-beast"; *dallag* (-*feoir*) = "blind one"; *feornachan*; *fionnag-feoir*; *labhallan* (*lamhalan*); *luch fheoir*; *luch shith*; *truth*. Manx—*thollag-airhey* (Kelly). Welsh—*chwistl*; *llygoden goch* (=red mouse); *llygoden y maes* (=field-mouse).

The local names, including the Celtic, must be taken without reference to any particular species, except where, as in Ireland and the Isle of Man, the Pygmy Shrew alone occurs. The names peculiar to the Water Shrew will, however, be given under that species.

Distribution :—Shrews of the present type are found throughout arctic, boreal, and transitional Europe and Asia, from sea-level to at least 6000 feet (Blasius); and from Great Britain to the Sea of Okhotsk (where the representative is *S. buxtoni* of Allen, described from Gichiga), as well as in Sakhalin and Hokkaido (representative, *S. diphæonodon* of Thomas). In Norway they are, perhaps, the commonest of all mammals right up to the snow-line on the mountains (Collett), and range from the extreme north ($71^{\circ} 10' \text{ N. lat.}$), together with corresponding latitudes in arctic Russia, southwards to beyond the Pyrenees, middle Italy, Hungary, ?Turkey, ?Greece, and northern Caucasus; but exact details are wanting for Asia, and even for southern Europe, where *Sorex* tends to be replaced by *Crocidura*, as is the case in the Mediterranean islands, in Asia Minor, and in northern Africa. *S. araneus* has only recently been proved to occur in Spain, although often wrongly reported and evidently confounded with Cabrera's *Neomys anomalus*. It is represented in Alaska by *S. pribilofensis* of Merriam, of the Pribiloff Islands, Bering's Sea; and in North America by the closely related *S. richardsoni* of inexactly known distribution in boreal zones from Ontario and Wisconsin, westwards to Alberta, and north to Great Bear Lake (Thompson Seton). That it crosses the arctic circle in Siberia is proved by Dobson's specimens from the Khatanga and Olenek rivers mentioned in *Proc. Zool. Soc.* (London), 1891, 350.

The Common Shrew is numerous throughout the mainland of **Great Britain** to the extreme north of Scotland (Kinnear, *Ann. Scott. Nat. Hist.*, 1907, 49), as well as in Anglesey, Bardsey, whence Coward has sent me specimens, Wight, and Jersey (Bunting). It frequents every kind of locality from sea-level probably to the summits of the mountains, *e.g.*, to 1300 feet in Yorkshire (Clarke and Roebuck), and at least 1500 feet in Cheshire (Coward and Oldham). It is absent from **Ireland**, Man, Lundy, the Outer Hebrides and Orkneys, where *S. minutus* is alone found; but, despite statements to the contrary, it is present and often common on many of the Inner Hebrides, such as Islay (W. Evans, *Ann. Scott. Nat. Hist.*, 1905, 116; Russell, *Zoologist*, 1910, 113) and Jura, from which last I have examined specimens procured respectively by W. Evans and the late Henry Evans. It is common in Arran and Mull (Alston), occurs in Skye (Buxton, *Zoologist*, 1908, 189) and Bute (Boyd Watt), and doubtless frequents many of the smaller islands. It is doubtful if any shrew is found on the Shetlands, and the species said to occur on Iona (see Lydekker, also Harvie-Brown and Buckley) has not been identified.

Distribution in time :—*Sorex araneus* first appears in Britain in the latest Pleistocene deposits, *e.g.*, those of the Ightham Fissures, Kent, and the Dog Holes Cave, Warton Crag, Lancashire. It has been recorded from several older horizons, but Hinton's recent study of the

material upon which these records were based has shown that in all cases the specimens are referable to other and extinct forms (see above, under genus *Sorex*, p. 80).

Description (taken from 250 British specimens):—In form the Common Shrew is typical of its genus (see above, p. 77, etc.). The body is shortened and the back elevated when at rest, but capable of considerable extension when the animal runs. The rounded pinna of the ear is small, and scarcely visible above the fur. The whiskers or vibrissæ are well developed and reach a length of 12 mm.

The **hand** and **foot** (Plate VIII.) have the soles naked, but covered with small tubercles, and the under side of the digits transversely corrugated. Except that the hand is much shorter than the foot, the general plan of each is similar. The central digit is slightly longer than the fourth, and the fourth than the second. These three digits arise from about the same position; the first and fifth are much shorter, especially the first, and arise well behind the other three. The tip of the first (both in hand and foot) reaches only to about the pad at the base of the second; the fifth reaches just beyond the base of the fourth (compare Lesser Shrew below, p. 112). There are six prominent pads, placed one each at the bases of digits one, two and five, one at the junction of digits three and four, and two posteriorly on the sole, one each behind the pads of digits one and five.

The **tail** varies in length, but is generally about half as long as the head and body; it is often four-sided, the angles being rounded, not sharp; it is of nearly equal diameter throughout its length, not tapering to the extremity; it is covered throughout its length with a number of short, closely set, and rather stiff hairs, but is without the inferior "keel" of *Neomys fodiens* (see Plate IX., Fig. 2, and Plate X., Fig. 2, for head; for tail, Plate VII., Fig. 2; for hand and foot, Plate VIII., Figs. 1 and 2; for ear, Plate VI., Fig. 1).

The **fur** is thick, soft, and silky, reaching on the back in winter a length of about 5 mm., but being about 2 mm. shorter in summer.

The **colour** of the upper side from the back of the head or occiput to the base of the tail is in winter usually very deep "seal brown," almost "clove brown," passing rather suddenly on the flanks into a band, about 7 mm. broad, of "broccoli brown," or "wood brown," and thence insensibly without line of demarcation into the dirty or yellowish white of the underside and feet. The dorsal area of brown is broadest over the lumbar region and narrowest just behind the shoulders. The face, and sometimes the head, is lighter than the back. The line of demarcation is indistinct, and runs from a point anterior to the angle of the mouth on each side to the shoulder, whence it coincides with the upper border of the above-described "flank-band,"

and terminates near the anus. The tail is bicoloured—"seal brown" above, "broccoli brown" below.

In summer the upper side is typically grizzled "mummy brown," many of the hairs being tipped with lighter shades. The flank-band is less clearly defined, and there is a stronger wash of yellowish on the under surface.

The first coat of the young resembles that of the parents in summer, and also that of the adult Pygmy Shrew, but displays a peculiar iridescence which is lost in adults (English). The hidden basal portions of the hairs are everywhere and at all seasons "clove brown," or "slate black."

A **moult**¹ occurs normally twice a year, viz., in spring (instances examined from 12th April to 14th June) and in autumn (14th September to 7th October). Frequently, but not invariably, the change is seen first on the head in spring, proceeding abruptly backwards and frequently leaving a sharp division between the fore parts of the body, which may be in summer coat, and the hinder parts, which may still carry the winter pelage. The winter coat is resumed in the reverse order, starting from the posterior end of the body, so that in autumn again there are found individuals in which the fore and hinder parts of the body are in different pelages.

The square appearance of the tail, which gave rise to the technical name *tetragonurus*, is most evident in the summer months, when the hairs have been shed or are worn down. In this condition the angles are rounded and not sharp, and the shape of these arises from the vertebræ as seen through the skin. At the same time the feet are often naked and the ears bare. The dates at which these parts (feet, ears, and tail) are found bare suggest that they may not follow the routine of the pelage moults, but may change their hairs only once a year at a variable date during summer.

Common Shrews exhibit a high degree of **individual variation**, the cause of which is not understood. The tints of the upper and under sides are especially liable to aberration from the normal, and the flank band may be entirely absent, its place being taken by a quite indefinite line of demarcation. Much irregularity is manifested in regard to the exact time of the moult, and many specimens are found with the long winter coat combined with the colours of summer, and even more frequently with the short summer coat coloured as in winter. These suggest the coloration of certain continental subspecies. I find considerable uniformity of colour in September, just before the autumnal moult.

Extreme summer specimens reach tints in the neighbourhood of "wood brown," and so merge into true *S. castaneus* of Jenyns, a rufous

¹ These moults and the manner in which the fur is changed were mentioned by Witchell and Strugnell, *Fauna and Flora of Gloucestershire*, 1892, 9.

variety of a "tint, in the recently killed animal, . . . quite as bright and decided as in the harvest-mouse or squirrel."

Specimens from East Anglia are usually more brightly coloured, with darker back, sharper line of demarcation, and more plainly marked "flank-band," which in winter results in a distinctly tricoloured appearance. The summer coat is often almost as dark as that of winter, and melanism generally is frequent, in which case the flank-band may be obliterated. This form appears to approach, if indeed it be not identical with, the subspecies *S. a. araneus* of central Europe.

The length of the tail is a very variable feature.

Exceptional colour-variation and sports:—Melanism is rare in *S. a. castaneus*, but frequent in true *araneus*. Gurney records an example of this kind of variation from Norfolk (*Zoologist*, 1879, 123).

Albinism is much more abundant than melanism in British shrews, and the occurrence of at least four albinos, in one case a male with pink eyes, has been placed on record (Bartlett, *Journ. cit.*, 1843, 287; Grabham, *Journ. cit.*, 1895, 268; Hollis, *Journ. cit.*, 1910, 307; Forrest, MS.). Other less definitely described specimens are an "albino" mentioned by Coward and Oldham, a small white female from Somerset, in the British Museum, and two in J. Whitaker's collection (see *Field*, 19th February 1910, 333). Service has figured a cream-coloured specimen (*Ann. Scott. Nat. Hist.*, 1896, 202; and 1903, 67, pl. i.); another was noticed in 1868 (Bladon, *Zoologist*, 1868, 1096), while a white shrew with brown tail-tip and a slight ashy tint on the upper side both of head and body is in the Royal Scottish Museum (Traquair, *Ann. Scott. Nat. Hist.*, 1902, 117).

Partially white specimens are quite frequent; sometimes they are whitish all over, or they may be finely powdered with white so as to resemble somewhat the colour and appearance of a "roan" horse. But more often the white appears either as a tip to the tail, or as a spot near or over the occiput, between, but a little behind, the ears. This is probably the "grey patch" which English has known to be developed on the head of a captive specimen and which he suggests may be due to poor condition. Of the latter variety I have examined five specimens. Many (in some localities the majority) have conspicuous white hairs on the ears, and others have spectacle-like marks around the eyes. Perhaps the most remarkable recorded variation is the pied skin described by Bell as having a broad white band over the loins, extending completely around the body; the interest of this variety is increased by the fact that Rope has met with an almost similar one (*Zoologist*, 1883, 220).

The general characteristics of the **skull** and **dentition** have been already described under the heading of the genus. In *S. araneus* the skull is rounder, larger, and more strongly built than in *S. minutus*. The teeth (Fig. 24, No. 1), are markedly larger, and the relative size



FIG. 24.—SIDE VIEW (diagrammatic and greatly enlarged) OF TEETH OF—(1) *Sorex araneus* ; (2) *Sorex minutus* ; and (3) *Neomys fodiens*. The portions of the teeth shown black in the diagram are in nature reddish.

of the unicuspid of the upper jaw is different. In both species they decrease in size gradually from front to back like a flight of stairs, but, whereas in *minutus* the first three teeth are not of markedly uneven size, in *araneus* the third is very distinctly smaller than the second, so that the "step" between these two teeth is abrupt. In both species the last unicuspid is minute, especially so relatively in *araneus*, in which it often lies so much interior to the general line as to be barely visible from the outside. In the first upper incisor the posterior lobe is relatively thicker than in *S. minutus*, the length of its base being about equal to that of the base of the anterior cusp; and in the first lower incisor the three lobes diminish regularly in basal diameter from front to back, but with the largest gap between the first and second. But it must be remembered that all these distinctions, except the first and last, undergo fundamental alterations as the sharp points of the teeth wear away with age and use.

Geographical variation:—The colours of the British Common Shrew (*S. a. castaneus*) are duller than those of *S. a. araneus*, which is a brighter and more distinctly tricoloured animal, ranging from eastern Skandinavia to central Europe, and, as stated above, probably also to the east of England. Each of the above has the tail as a rule less than, or not exceeding, 45 mm. long. Two other sub-species, *S. a. tetragonurus* (Hermann), of the Alps and neighbouring regions east to Transylvania, and *S. a. pyrenaicus* of Miller, of the Pyrenees, are characterised by a tail usually exceeding 45 mm. in length. The former is a darkly-coloured animal with the back frequently blackish in summer; in the latter the back is never blackish in summer. Miller has further described:—*S. a. euronotus* of the plains of south-western France, a dully coloured animal, with slight cranial peculiarities; *S. a. fretalis* of Jersey, with the rostrum deepened and broadened, and the anterior teeth enlarged; *S. a. granarius*, known only from Segovia, Spain, the smallest known form, with a skull resembling that of *S. a. fretalis*; and *S. a. bergensis*, a large dark shrew from the Atlantic slope of western Norway. *S. a. santonus* (Mottaz), from Charente, France, has blackish under-parts not in contrast with the back. Miller unites my *S. a. carpathicus* from Transylvania with *S. a. tetragonurus* (see Barrett-Hamilton, *Ann. and Mag. Nat. Hist.*, May 1905, 505-508).

Another sub-species, *S. a. borealis* of Kashtchenko, described from western Siberia, is not available for examination. No doubt the American *S. richardsoni*, being only distinguishable from *S. araneus* by its longer coat, slightly darker coloration, and some details of dentition, may be regarded as of merely subspecific value.

DIMENSIONS IN MILLIMETRES:—

	Head and body.		Tail (without terminal hairs).		Hind foot (without claws).		Ear.		Weight in grammes. (<i>Fide</i> Adams.)
	MALES.								
No. of items . . .	63	219	61	188	61	181	12	40	62
Maximum	82	84	45	47*	14	14	8.5	8	14
Average	74	72.5	39	40	13	12.7	7.45	7.8	10.6
Minimum	62	64	32	35	..	12	6	6	6.5
	FEMALES.								
Number of items .	99	166	99	155	99	145	32	31	65
Maximum	83	84	46	47*	14	14	8.5	8	16
Average	70	72	38.5	39.5	13	12.6	7.7	7.1	9.2
Minimum	58	60	33	30	..	12	6.5	6	6

* Twice only for each sex.

Of the **dimensions** given in the above table, those in the left-hand columns were taken from the labels on specimens in the British Museum of Natural History, immature examples being, so far as possible, excluded. Those in the right-hand columns were sent me by Adams, and the two sets agree so closely, as well as do others received from Buckinghamshire (Cocks) and Devonshire (Hollis), that the averages may be taken as fairly correct for specimens all the year round. But, as shown by Adams, to whom I am indebted for numerous valuable notes amplifying his paper (noticed on p. 108), the average size of adults varies throughout the year, being at its maximum in June, and thereafter decreasing until winter, and, if his contention be true that the life of a shrew reaches only about a year, then true adults would only be obtainable from May to December, and during the rest of the year all specimens would be immature. It follows that an average, taken from specimens captured at a particular season would not agree with that for the complete year. Thus, twenty-four adult males taken by Adams in May, June, and July, 1911, averaged 81 for length of head and body, and reached, in two cases, a maximum of 84. Eighteen females taken under the same conditions averaged 82, and reached the same maximum six times. The largest specimen of which I have a reliable record was taken by Kinnear in Scotland; it reached 88 (head and body), 39 (tail), 13 (hind foot).

Allen found that in *S. buxtoni* (*Bull. Amer. Mus. Nat. Hist.*, 1903, 181), an East Siberian representative of *S. araneus*, males are larger





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than females, but this is not supported by the figures given above for British shrews, amongst which no recognisable difference in size between the sexes has been shown to exist.

Proportionate lengths:—Tail (without end hairs) about $\cdot 5$; hind foot about $\cdot 17$ to $\cdot 18$; ear about $\cdot 1$ of head and body.

The **weight** (in grammes) shows a seasonal variation corresponding to the dimensions. Adams's twenty-four males noticed above averaged 12, with a minimum of 10 (once) and a maximum, reached three times, of 14. The discrepancies were generally due to the amount of food contained in the stomach. Adams's eighteen females varied between 9 (once) and 16 (twice), and averaged 13.1, their superiority over the males being due to the fact that many of them contained embryos. An increase of weight after March is independently corroborated by Kinnear (MS.). The facts have an important bearing on the much-discussed autumnal mortality discussed below on pp. 104-108.

Skull:—Greatest length, 19; basal length in middle line, 16; palatal length in middle line, 8; length of upper tooth-series, 8 to 8.5; ditto of lower, 7.5 to 8; greatest breadth, 9; breadth at constriction, 4.

Status, etc.:—The distribution, both modern and geological, of *Sorex araneus* points to its having first appeared in Britain at a comparatively recent date. As compared with *S. minutus*, its greater plasticity and more marked tendency to individual variation indicate a more recent species. In its more complicated changes of pelage it is more specialised, but its greater size and less elongated body denote a more generalised form.

Distinguishing characters:—The larger size, shorter and less hairy tail, shorter and more slender nose, and generally more striking, usually tricoloured, coloration, with the distinct pattern of the teeth, make the identification of the Common Shrew an easy matter. The characteristics of the Pygmy Shrew will be given under heading of that species.

The small size, quite as much as the retiring habits of the Common Shrew, makes observation of its movements difficult.¹ Its long and pointed snout, flexible form, and compact velvety coat, enable it to pass through the closest herbage, or beneath the carpet of dry leaves in the coppices and woodlands, in which situations, as well as in the open fields, whether of grass or tillage, it seeks its food. Its habit is to pass into or through any crevices or passages which may come in its way, and thus it probably avoids the construction of burrows on its own account.

¹ See, however, Douglas English's *Some Smaller British Mammals*, Bousfield and Co., Ltd., London, undated. This little book contains a number of interesting photographs.

It is widely distributed over almost every kind of country, and would seem to be equally at home on plain or mountain, and it is, besides, occasionally a climber of trees.¹ Unfortunately, in many cases where individuals have been met with at high altitudes, the species has not been carefully noted. Thus George Sim is responsible for the statement that the Common Shrew occurs upon the summits of the highest mountains of the Dee area in the north-east of Scotland, but his observations lack precise value from the fact that he does not mention the Pygmy Shrew in his book. Again, though it was known that shrews had frequently been caught by the cats at the observatory on the summit of Ben Nevis, it was left to Colonel H. W. Feilden to record² the fact that one at any rate of the victims was a Pygmy Shrew, so that it is still uncertain whether the present species reaches the summits of our highest mountains. We have, however, the authority of Messrs W. Eagle Clarke and W. Denison Roebuck, that it ranges to 1300 feet in Yorkshire, and we know that in continental Europe shrews ascend to at least 6000 feet,³ and in Norway to the snow-line, so that the Common Shrew is probably one of the most widely distributed, abundant, and hardy of our British mammals.

Mr Rope,⁴ who has remarked on its semi-aquatic habits, has found its nests by the sides of ditches, and in such cases the occupants when disturbed have often taken to the water, swimming with great ease. On one occasion, after a sudden flood, he found numbers of them on small islands, where in some places only the broken-down stems of the reeds were left unsubmerged. About these the shrews were running with remarkable activity and at times they seemed to be actually treading upon the surface scum, which, with a few floating odds and ends, was sufficient to support their weight. Mr A. H. Cocks writes me that he once received a specimen which had been caught by a man while bathing.

Despite many assertions to the contrary, shrews are active in winter, especially in the daytime. Even in Siberia, as shown by the American naturalist, Mr N. G. Buxton,⁵ they do not

¹ G. T. Rope, *Zoologist*, 1886, 26.

² *Ann. Scott. Nat. Hist.*, 1897, 42.

³ *Fide* Blasius.

⁴ *Zoologist*, 1873, 3525.

⁵ *Bull. Amer. Mus. Nat. Hist.*, 31st March 1903, 182.

hibernate. It is probable that a spell of snowy weather is quite the best time for trapping them,¹ and during the great frost of 1895, when snow remained so long upon the ground, Mr G. H. Caton Haigh constantly caught both this and the smaller kind. Sim's "composite" species was seen by one of his informants to take shelter under a small patch of snow on the summit of Ben Muich Dhui, and I have examined specimens taken in midwinter in Skandinavia, at which season Dr N. F. Ticehurst found them quite lively. Occasionally in the cold season both the present and the succeeding species enter and ascend the dwelling-houses² of man, and they have secure underground winter retreats; but whether or no they dig them for themselves, as MacGillivray thought, is not certainly proved. They certainly spend much of their time in the runs and burrows of mice, and their weak claws are not suitable for extensive excavations. But like other mammals no better equipped, they are probably capable of digging when necessary. In summer they forage far afield over open country and may be found in any low-growing vegetation, but in winter they retire to the shelter of hedgerows, where they live largely in holes, in crannies, and in cracks of walls. In such quarters, by the help of the elongated and mobile snout carrying the prominent nostrils at its extremity, they search out the hibernating insects and their eggs, which, according to Professor R. Collett, are their main food at that season.

Although frequently found abroad by day, the Common Shrew is probably at least equally a creature of the night. It is, indeed, so voracious and its hunger so ungovernable that it must work hard to satisfy the calls of its appetite.

Its food consists largely of insects, worms, and small invertebrates generally, of which it consumes great quantities. It eats molluscs, both small and big, as observed by R. F. Tomes,³ who fed captives with them; he also found the fragments of small shells⁴ in its runs, and took the remains of a slug⁵ from its stomach. There can be no doubt too that under pressure of

¹ See also William Evans, p. 27.

² *Fide* Millais; Gadeau de Kerville; J. H. Gurney, *Zoologist*, 1879, 123; according to Collett, many enter the houses in Norway in autumn and winter.

³ In Bell, ed. 2.

⁴ *Vitrina pellucida* and *Zonites*.

⁵ *Agriolimax agrestis*.

hunger, it will attack less ignoble game, such as young frogs. These, as well as lizards, small birds and their eggs, and mammals, are included in its dietary by Victor Fatio and Monsieur Henri Gadeau de Kerville. The latter observation has often been corroborated by trappers of the smaller mammals, whose captures are constantly subjected to attacks, and in Norway it damages snared willow-grouse and is never absent from fish-curing stations (Collett). Shrews cannot resist carrion of any sort. In consuming mice, they sometimes turn the skin inside out, after the manner of a cat with a rabbit;¹ but Mr L. E. Adams finds that the almost invariable rule is to begin the meal at the upper ribs, eat into the carcase, and finish at the brain. Leonard Jenyns declared that they relish vegetable matter, and Charles St John stated² that they will bark trees; but no corroboration of these statements has been forthcoming in recent years for Britain; their tastes certainly descend to cheese, bread, aniseed, and even nuts when used as a bait.

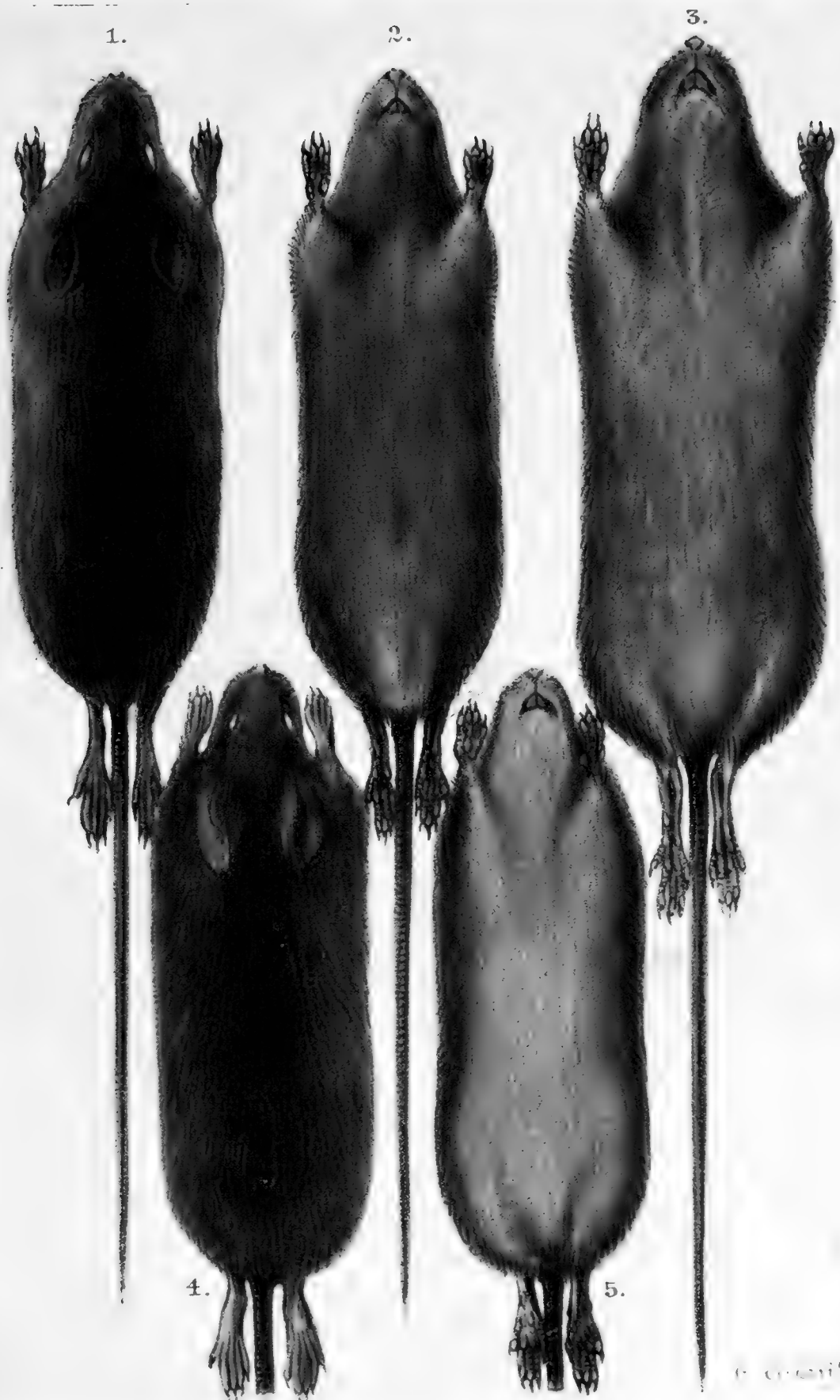
It is certain that they much prefer a diet of living things, but animals which thrive right up to the North Cape, in Norway, and are active throughout the Arctic winter, can hardly afford to be particular about what they eat, and Professor Collett remarks that in Norway they eat soft vegetable food when occasion arises, and can be caught with apple or greenstuff as a bait.

American naturalists describe their "shrews" as being about as omnivorous as any creatures could well be, their diet varying from mice, which they take a special pleasure in killing, to grain when no other food is available. These remarks, however, refer more particularly to the Short-tailed Shrews or Blarinas,³ the habits of which are better known in America than are those of the Soricidæ representing our own species. But, since in their appetites the smaller shrews differ from the larger only in so far as they are affected by lesser size and weaker power, all may be expected to have similar propensities. Dr C. Hart Merriam observed a captured Blarina of 11.20

¹ N. B. Kinnear.

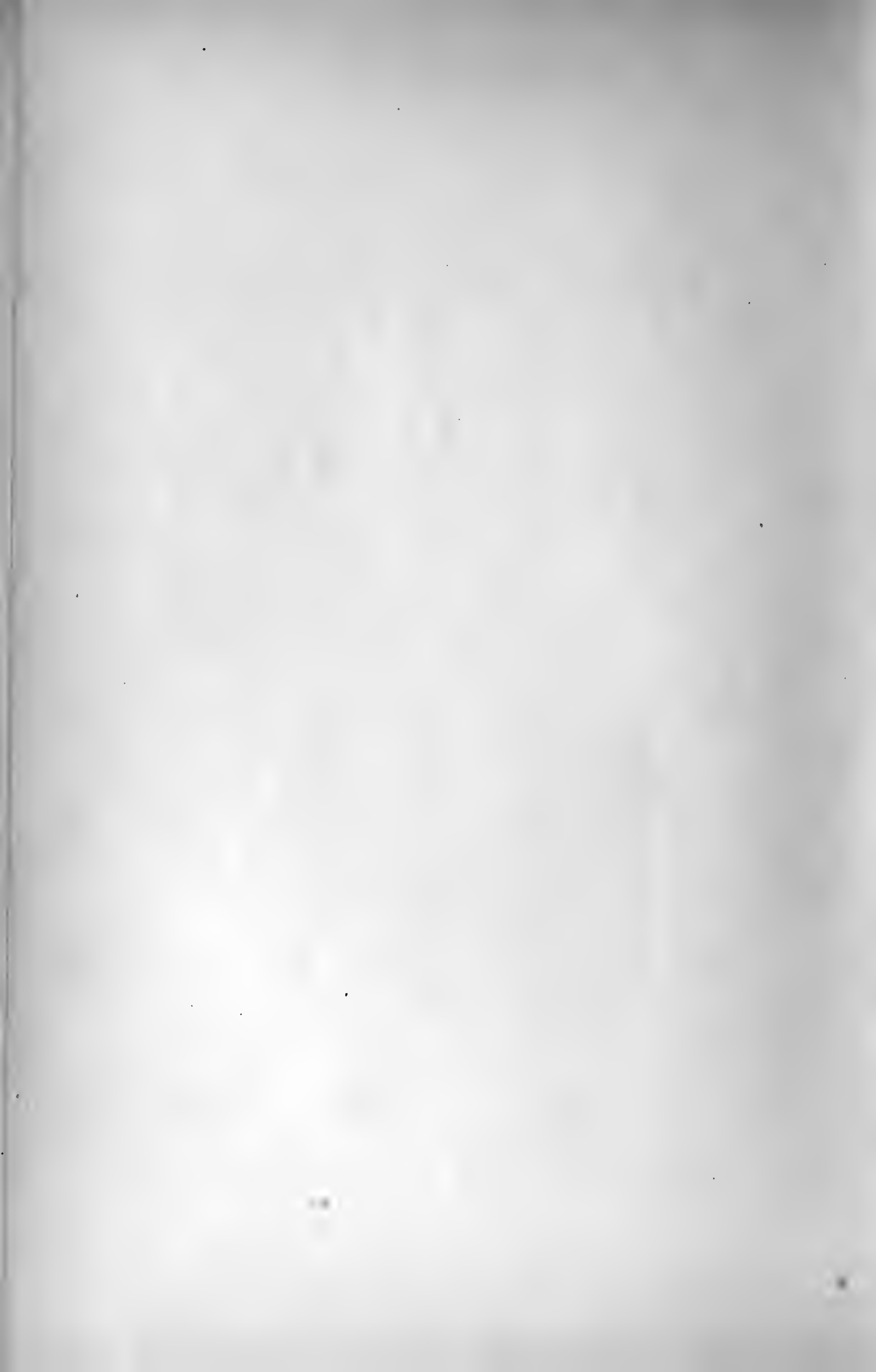
² *Natural History of the Highlands*; the trees could only have been very young ones.

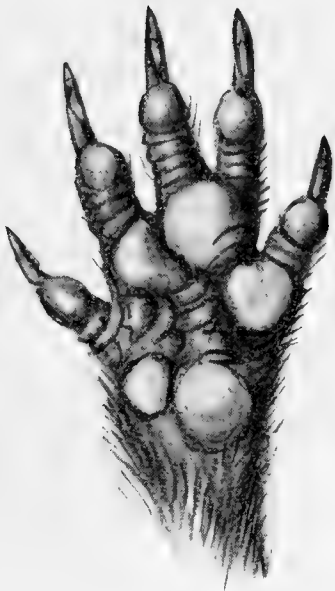
³ Genus *Blarina*.



G. C. C. C. C. C.

HOUSE MOUSE.





(1)



(2)



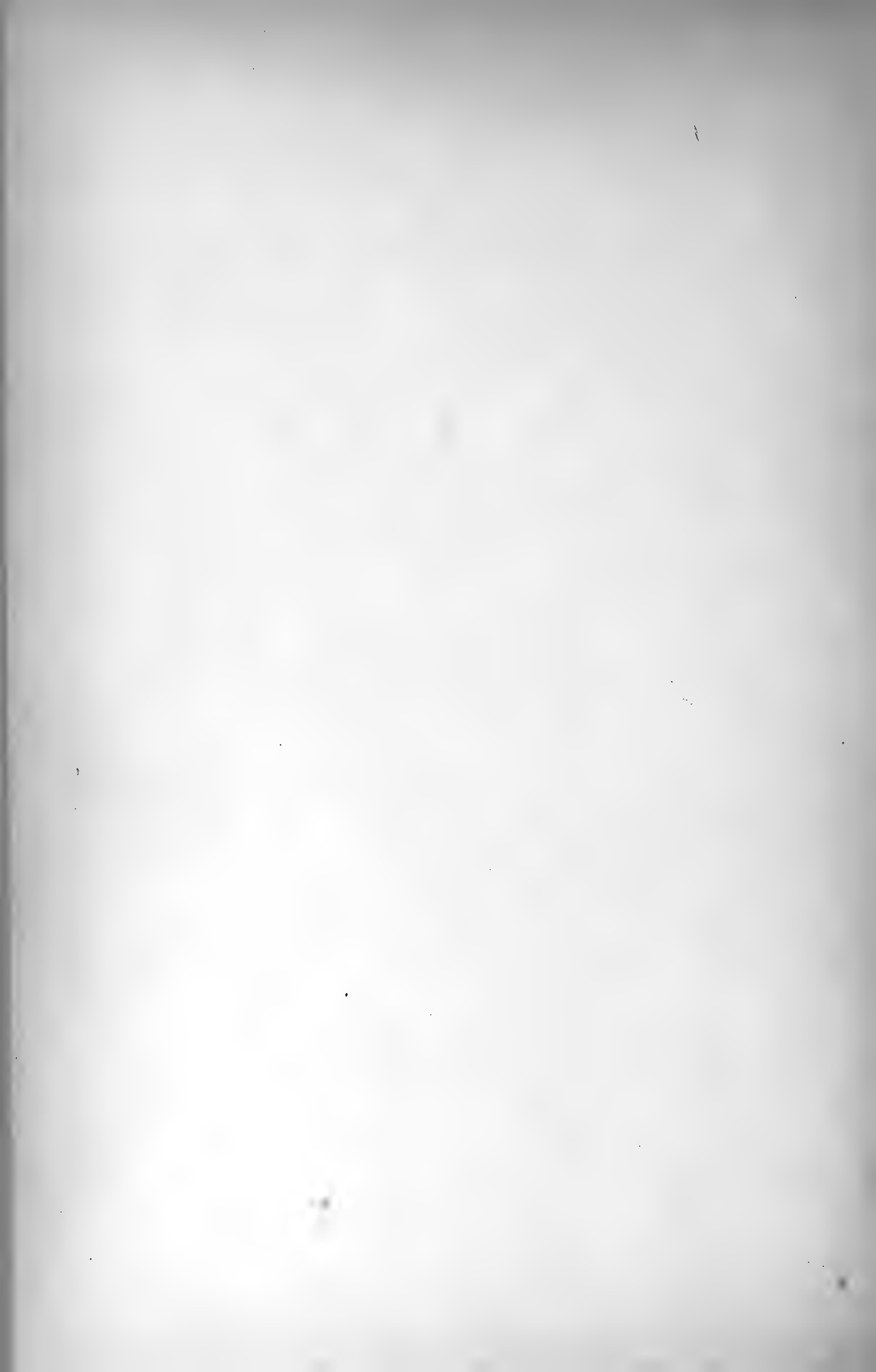
(3)



(4)

THE HEDGEHOG.

(1) LEFT HAND; (2) LEFT FOOT; (3) LEFT EAR; and (4) DORSAL VIEW OF TAIL.
(1, 2, and 3 magnified $1\frac{1}{2}$ times; 4, life size.)



grammes weight tire out, kill, and partially devour a mouse weighing 17 grammes. The killing and subsequent meal occupied a full hour.¹

Mr Rope² has observed that shrews tunnel rather frequently in dry cow-dung, no doubt for the purpose of eating the invertebrates which find their sustenance in it. In captivity their appetite is so remarkable that it seems to merit a special paragraph, and will be described below.

This animal, like the Mole, is very pugnacious, especially in the breeding season,³ so that it is rare to see two of them together except in the act of fighting or pairing. Mr J. G. Millais once discovered a pair locked in the embrace of mortal combat, and Mr T. A. Coward has found fur in the mouths of dead shrews, which, judging by their wounds, must have perished while fighting. When moving about they frequently utter a series of shrill squeaking cries, which, like those of bats, are not clearly audible to everyone, and which probably indicate a highly nervous and excitable disposition. Sometimes they turn to pursue a comrade, and, if battle be refused, the resulting chase is conducted in leaps of fully two feet each. The best description of their voices which I have seen was penned many years ago by John Wolley, who wrote that the "low sibilous notes may not inaptly be called whispering."

The irascible nature of the Shrew is even more manifest in captivity; no box is large enough to contain two of them at peace, and one will fight with any other creature of about its own size.

If two be confined in a box together, a very short time elapses before the weaker is killed and partly devoured, the victor not hesitating to tear out the intestines of the vanquished. C. A. Witchell⁴ has described the fury of a captive which, having disembowelled a comrade, attacked with equal ferocity snakes, slow-worms, and vipers, from an unequal conflict with which it was removed unhurt in body and unsubdued in spirit.

"A duel between Shrew-mice," writes Mr English, "is,

¹ *Vertebrates of the Adirondack Region*, 69-70.

² *Zoologist*, 1886, 26.

³ At this season both males and females show signs of conflict, particularly about the feet and tail, which are often quite denuded of hair and covered with wounds (Adams, *op. cit.*, *infra*, p. 108).

⁴ *Zoologist*, 1883, 293-294; *Fauna and Flora of Gloucestershire*, 1892, 9-10.

as might be expected from their strenuous nature, worth watching. The commencement on both sides is circumspect. The combatants advance, squeaking, with wide-open jaws and snarling muzzles, squirm round each other, jump clear across each other and at each other. Their jumps, from all four feet, are, considering the shortness of their legs, extremely neat and vigorous. Finally, one or the other gets a hold, often on his opponent's tail, and here the real business begins. They fasten head to tail and tail to head, and spin as a living ball, until the spin itself releases them. After a few seconds' rest, during which they are often lying on their backs squeaking defiance, a second round commences, and after that a third, and fourth, and fifth. I have never witnessed a duel which terminated fatally; but with well-matched adversaries, it must be a prolonged affair, ending only in the complete exhaustion of one or the other combatant."

In spite, however, of their unenviable temper, these little creatures afford interesting material for observation, but I am unaware of their having survived capture longer than a few months, and that period only under the care of Mr Cocks or Mr English. They never become sufficiently advanced in the rudiments of domesticity as to merit the title of "pet." Hunger soon drives them to take worms or insects from the hand, and they become so far "trained" as to associate certain regularly repeated noises with feeding time. But this action must not be regarded as an indication of docility, but rather as a mere blind submission to an uncontrollable desire for food. This imperishable hunger is, in truth, the greatest obstacle to their health in confinement, for a lavish supply of food must be kept ready for them by day and night, if they are not to die of starvation.

Several naturalists have published their experiences of the demeanour of the Common Shrew while in captivity. Amongst these Mr English's recently published observations should be read by every one interested in British mammals. He states that shrews, when they are really thirsty, drink with a curiously bird-like action. The snout describes a small arc in the water, and, at the end of its sweep, points almost perpendicularly upwards.

One possessed for a fortnight by Mr Henry Barclay¹ would eat two or three dozen cockroaches in a night, seizing them behind the head and devouring from thence backwards all except the hard portions of the legs and wing-cases. In its habits it was very active, always on the move, and usually making a shrill squeaking noise while hunting for food. When frightened it emitted a disagreeable musky smell.

E. R. Alston² kept a Common Shrew for a few days in a box with moss, and observed that it seized house-flies with a spring, eating seven or eight at a time; if more than that number were given to it, it hid them amongst the moss in its box. "Small worms were caught by one end and munched slowly without being bitten through. On giving it a large one (about four or five inches long) it gave it a sharp bite, then sprang back, then flew at it again, until the worm was half-dead, when it ate about half and hid the rest. It slept during the middle of the day, rolled up among the moss, but always waked up at once if worms or flies were put into the box." Alston believed that "when pressed for food, shrews will kill and eat frogs, but when a large one was placed in the box the present specimen did not seem inclined to prey upon it, although now and then it gave it a slight bite on the hind leg; after they had been together for some hours the poor frog was taken away. The shrew seemed to be very cleanly, constantly dressing its fur and 'washing' its face with its fore-paws, as rabbits do."

The late Mrs Eliza Brightwen also wrote³ a very entertaining account of a shrew which made for itself, inside the glass globe in which it lived, a domed nest with three entrances and covered runs. It was so voracious that "a full-grown mouse will barely supply enough food for . . . four-and-twenty hours."

Anyone who wishes to amplify the above observations can easily do so, since this Shrew is one of the most easily trapped, and perhaps the most universally abundant of all our small mammals, in this respect vying with small rodents and coming to almost any bait.⁴ It seems to have no fear or suspicion of

¹ *Zoologist*, 1848, 1957.

² *Journ. cit.*, 1864, 9358-9359.

³ *More About Wild Nature*, 1892, 3-10.

⁴ R. I. Pocock has used plum pudding.

a trap, which, in fact, at least in my own experience, is likely to be very successful if placed in the most open and conspicuous position available.

It is an old observation often repeated, that dogs and cats, although they kill, will not readily eat the Common Shrew, and their aversion may probably arise quite as much from the early putrefaction undergone by a shrew carcase, as from the rank musky odour which the species possesses. This odour, although not usually emitted except under the influence of fright, may also have been in some measure the cause of the ancient prejudices concerning its supposed power of inflicting injury by the mere contact of its body. On the other hand, examinations of the "pellets" or regurgitations of owls and other birds have long since¹ established the fact that they make no such nice discriminations, and that they destroy numbers of shrews; and it is certain also that carnivorous mammals will occasionally eat them.

The unfortunate creature was formerly the centre of a whole host of extravagant superstitions, which, like all ignorant prejudices, disappear but slowly from our midst, and probably still linger in the more inaccessible parts of the country. Its very name is an indelible brand of malignancy and spite, and must have owed its existence to centuries of misapprehension in many lands. From the time of Aristotle, who declared that its bite is dangerous to horses and other draught animals, and produces boils,² its presence has been regarded as something peculiarly noxious, so that a variety of the most extraordinary remedies and preventatives occur in the works of ancient writers. In England it was believed by running over an animal to produce lameness and even disease. Thus it was described in an old book³ as the "Shrew or Shrew-mouse,

¹ Pellets seem to have been first examined by Henry Turner, of the Botanic Garden at Bury St Edmunds, who published his conclusions in 1832 (see Loudon's *Mag. Nat. Hist.*, v., 727). Adams had a dead shrew brought to him from a magpie's nest, and has known trapped specimens to be eaten by *Evotomys*. J. E. Harting took one from the stomach of a stone curlew (*Vermin of the Farm*, 1892, 22).

² *Historia Animalium*, viii., 24, D'A. W. Thompson's ed., 1910, 604^b, 19. For Holland's translation of Pliny and Somner's version, see above, p. 85.

³ *New World of Words: or, Universal English Dictionary*, 6th edition, London, 1706, a revised version of *The Moderne World of Words, or a Universal English Dictionary*, collected from the best authors by E. P. (Edward Phillips: 1st ed., 1696).



(1)



(2)



(3)

LEFT EARS OF (1) COMMON SHREW (5 times life-size); (2) PYGMY SHREW (7 times life-size); and (3) WATER SHREW (4 times life-size), the latter with tuft of white hair on superior valve (*a*). The lobes for closing the ear are marked—*a*, superior; *b*, antitragial; and *c*, small tragal.

a kind of Field-Mouse of the bigness of a Rat and colour of a Weasel, very mischievous to Cattel, which going over a Beast's Back, will make it Lamè in the Chine ; and the Bite of it causes the Beast to swell to the Heart and die." But the poor creature's fair name was never, I suppose, more foully besmirched than by Edward Topsel, who spared no details in his description of its crimes.

"The Shrew," he wrote, "is a ravening Beast, feigning it self gentle and tame, but, being touched, it biteth deep, and poysoneth deadly. It beareth a cruel minde, desiring to hurt any thing, neither is there any creature that it loveth, or it loveth him, because it is feared of all. The Cats, as we have said, do hunt it and kill it, but they eat not them, for if they do, they consume away in time. They annoy Vines, and are seldom taken, except in cold ; If they fall into a Cart-road, they die and cannot get forth again, as *Marcellus*, *Nicander*, and *Pliny* affirm. And the reason is given by *Philes*, for being in the same, it is so amazed, and trembleth, as if it were in bands. And for this cause some of the Ancients have prescribed the earth of a Cart-road, to be laid to the biting of this Mouse as a remedy thereof. They go very slowly, they are fraudulent, and take their prey by deceit. Many times they gnaw the Oxes hoofs in the stable. They love the rotten flesh of Ravens ; and therefore in *France*, when they have killed a Raven, they keep it till it stinketh, and then cast it in the places where the Shrew-mice haunt, whereunto they gather in so great number, that you may kill them with shovels. The *Egyptians* upon the former opinion of holiness, do bury them when they do die. And thus much for the description of this Beast. The succeeding discourse toucheth the medecines arising out of this Beast ; also the cure of her venomous bitings."

Only one or two examples may be quoted from this truly devilish pharmacy. Thus :—

"The Shrew, which falling by chance into a Cart-rode or track, doth die upon the same, being burned, and afterwards beaten or dissolved into dust, and mingled with Goose grease, being rubbed or anointed upon those which are troubled with the swelling . . . doth bring unto them a wonderful and most admirable cure and remedy. The Shrew being slain or

killed, hanging so that neither then nor afterwards she may touch the ground, doth help those which are grieved and pained in their bodies, with sores called fellons, or biles, which doth pain them with a great inflammation, so that it be three times invironed or compassed about the party so troubled. The Shrew which dyeth in the furrow of a Cart-wheel, being found and rowled in Potter's clay or a linnen cloth, or in Crimson, or Scarlet woolen cloth, and three times marked about the Impostumes, which will suddenly swell in any man's body, will very speedily and effectually help and cure the same.

"The tail of a Shrew being cut off and burned, and afterwards beaten into dust, and applyed or anointed upon the sore of any man, which came by the bite of a greedy and ravenous Dog, will in very short space make them both whole and sound, so that the tail be cut from the Shrew when she is alive, not when she is dead, for then it hath neither good operation, nor efficacy in it."

And again:—"There is a very good remedy against the bitings of Shrews, or to preserve Cattle from them, which is this; to compass the hole wherein she lyeth round about, and get her out alive, and keep her so till she dye, and wax stiffe, then hang her about the neck of the Beast which you would preserve, and there will not any Shrew come near them; and this is accounted to be most certain."

The use of a well-known ancient antidote to these imagined injuries has now passed away; it consisted in the application of a twig of a shrew-ash, of the preparation of which Gilbert White¹ gives the following account:—

"At the south corner of the *Plestor*, or area, near the church, there stood, about twenty years ago, a very grotesque hollow pollard-ash, which for ages had been looked on with no small veneration as a *shrew-ash*. Now a shrew-ash is an ash whose twigs or branches, when gently applied to the limbs of cattle, will immediately relieve the pains which a beast suffers from the running of a *shrew-mouse* over the part affected: for it is supposed that a shrew-mouse is of so baneful and deleterious a nature, that wherever it creeps over a beast, be

¹ Letter xxviii. to Daines Barrington, 8th January 1776.

it horse, cow, or sheep, the suffering animal is afflicted with cruel anguish, and threatened with the loss of the use of the limb. Against this accident, to which they were continually liable, our provident fore-fathers always kept a shrew-ash at hand, which, when once medicated, would maintain its virtue for ever. A shrew-ash was made thus:—Into the body of the tree a deep hole was bored with an auger, and a poor devoted shrew-mouse was thrust in alive, and plugged in, no doubt, with several quaint incantations long since forgotten.”¹

Another cure was to make the shrew-struck person or animal pass through the arch of a bramble, both ends of which were rooted and growing; and in Cheshire the small twigs and young boughs of a shrew-ash were gathered and hung on the roof over cows before calving-time.²

The genital organs begin to become functional in February, and the rutting season commences in March, before which month the sexes are difficult to distinguish even by dissection. It is probable that the soft passion incites to much pugnacity, since Mr Millais has noticed that the fighting season begins in March. According to Professor Collett, a pairing female may be pursued by several males, and the chase is productive of much squeaking.

The length of the period of gestation is unknown, but it is not likely that it differs widely from that of the Water Shrew.

The blind and naked young, which may reach ten in number,³ are born in every month from April, although rarely in that month, to late November, Mr Oxley Grabham having met with a family of five half-grown young on the 1st October, and Mr Archibald Thorburn a nest as late as the 19th November.⁴ The varied dates suggest the probability that second or even third litters, follow the first at rapid intervals,

¹ For a similar practice, see Plot's *Staffordshire*, 222.

² J. F. Robinson in the *Manchester City News* of 30th June 1883, as quoted by Coward and Oldham.

³ See *Zoologist*, 1896, 432. Adams found 10 embryos (twice), 9 (once), 8 (six times), 7 (four times), 6 (once), 5 (once) 4 (twice), and 2 (once), in eighteen pregnant females. The average works out at exactly 7.

⁴ In Millais. Adams has captured recently impregnated females on 21st November (*op. cit.*, *infra*, p. 108).

for there is as yet no evidence that the young breed during their first summer.¹ The nursery,

“A wee bit heap o’ leaves and stibble,
Which costs it mony a weary nibble,”²

is most frequently found in hayfields at mowing time.³ It consists of soft herbage, dried grass, and withered leaves, and is placed in some hole or depression in the open ground, in a tuft of grass, under a heap of sticks, or upon a bank. It is usually described as resembling that of the Harvest-mouse and having a round, cricket-ball-like appearance without visible hole for entrance or exit, such movements being quite easily executed through the yielding walls, which, being drawn together again, tell no tales. Mr Adams, however, on careful examination of three nests, found that they were in reality cup-shaped. The roofs lay loose upon them and could be removed without injury. The occupants could slip out all round by passing between the roof and the cup, and this formation makes the statement more intelligible that even when the top has been shaved off by a mower, or the nest has been otherwise disturbed, the mother does not readily desert her young, but re-covers the nursery with grass; sometimes, however, she is said to remove the family to a new site. A fourth nest examined by Mr Adams was not so carefully constructed, being a mere ball of bitten grass. Mr William Evans sends me a note of an exceptional nest found near Dunbar by Mr G. Pow, which was placed in a young spruce fir, at about three feet from the ground, and formed entirely of thistledown. It contained a dead shrew. Mr H. E. Forrest reports a nest in a bee-hive which contained two old shrews and eight young ones.

The increase of the species which such a numerous progeny might be calculated to produce, is counterbalanced, not only by the destruction wrought amongst them by the agency of other

¹ Suckling females are heavily coated over the abdomen with glandular fat (Adams, MS.).

² As aptly quoted by J. J. Briggs, who has placed on record some interesting details; see *Zoologist*, 1848, 2280.

³ Some of the nests reported may have been built for dormitories, and not nurseries, as it does not seem to be known exactly how shrews sleep. They certainly construct sleeping nests in captivity.

mammals and by birds, but by a very general and mysterious mortality. This is most commonly observed in the autumn, but prevails also in summer and even in spring. Its cause does not appear to be thoroughly understood. So many shrews may be found lying dead on footways, or other bare ground near their haunts, as to have led to the belief mentioned above among country people, that one cannot cross a public way without incurring instant death. This mortality, as Tomes¹ was able to satisfy himself, extends to individuals of both sexes and of all ages. It is naturally more perceptible on roads or bare places, but if, as has been suggested, it is no less severe in woods and tall herbage, where it is necessarily impossible to appreciate its extent, then its magnitude must indeed be enormous. It is also associated with the two other British species, the Pygmy and Water Shrews, and must, therefore, be due to causes which affect all three alike.

Several plausible explanations have been put forward to account for this mortality. It has been attributed to sexual excitement² leading to wandering recklessness, and consequent capture by predatory animals,³ but, if that be so, it is difficult to understand why marks of violence upon the carcasses are comparatively rare, and further, why they are left uneaten, since, as already shown, shrews are not always refused by beasts and birds of prey.⁴ MacGillivray connected it with drought,⁵ resulting in scarcity of food, a suggestion only tenable had we evidence that the autumnal mortality is greater in countries of dry than in those of moist climate.

The late Robert Service, after examining some hundreds of wayside shrew carcasses,⁶ wrote me that he had formed the belief that, in the neighbourhood of Dumfries at least, the Hedgehog is the principal cause of shrew mortality. But that this cannot be so is shown by the fact that Mr Millais observed Lesser Shrews lying dead on a worn trail in North Uist, as I

¹ In Bell, ed. 2.

² J. L. Knapp, *Journal of a Naturalist*, ed. 2, 1829, 145.

³ Jonathan Couch, *Illustrations of Instinct*, 1847, 279.

⁴ They are killed by cats, and occasionally by dogs, but rejected by most beasts of prey. They are devoured by a few birds of prey, especially by Common and Rough-legged Buzzards, and by most of the owls, but not in numbers (Collett).

⁵ From this Adams believes that small rodents escape by migration.

⁶ See article on Hedgehog, p. 67.

have myself noticed the Pribiloff Island Shrew on St Paul's Island, Alaska, in autumn, and on neither island do hedgehogs occur.

A remarkable suggestion is that of Mr English, who, as quoted by Mr Millais, having observed that shrews die very readily, as, for instance, on the snapping of a trap by which they are themselves untouched, thinks that they may perish during thunderstorms or when the atmosphere is in an unsettled thundery state. Such a suggestion is one of those which is more easily advanced than substantiated, but, strange as it may seem, it cannot be regarded as absolutely unfounded on fact. I can myself corroborate the fact that a shrew may die on the mere snapping of a trap, and Mr F. G. Aflalo suggests, on plausible grounds, that they succumb readily from fear.¹ Many certainly perish in combats with adversaries no more terrible than their own species, and it may indeed be possible that a thunderstorm should occasionally affect them fatally.

Mr Cocks has pointed out to me that, as already stated, the Common Shrew is probably by far the most numerous mammal in the British Isles, as it is also, according to Professor Collett,² in Norway; and all the shrews are very prolific, so that the three species aggregated must total a vast multitude, of which many more must die each year than of any other mammal or group of mammals.

Anyone who has watched the gait of shrews of any species at close quarters, as in captivity, through glass, cannot fail to have been struck with the extreme feebleness displayed. They totter in every movement, exactly as if they were suffering badly from rickets; their legs barely support their weight, and they continually stumble over the slightest obstruction, such as a small bit of moss or grass, so that in the case of a freshly-caught individual one can hardly persuade oneself that one of its legs is not broken.

The instinct of any animal on finding itself ill in any way, is to hasten to some hiding place, where the dead body is in a great majority of cases not found; but the least accident of any

¹ *Field*, 13th August 1898, 279.

² "Norges vigtigste Hvirveldyr," in *Norge i det Nittende Aarhundrede* 1900, p. 85.

kind (including, as suggested above, a clap of thunder, or the snapping of a trap, which have no effect on larger animals) may be instantly fatal to these frail little creatures, leaving them no time to hide. Mr Cocks therefore thinks that the fatality may be caused by a multitude of different agencies, not one or other only of those already mentioned. Dead shrews are undoubtedly found now and then bearing the tolerably obvious marks of the beak of an owl; the singles of an owl, on catching so small an animal, may very often encircle the body without making any visible holes, but when the prey has been transferred to the bird's beak, the nip is left tolerably plain. If an owl saw any small rodent, it would perhaps drop the insectivore to pursue the more choice morsel.

Again, in the case of other animals dying in the open, as they "keep" for some time (depending of course on the species, the temperature, and the degree of dampness), there is a chance of the body being found and eaten or dragged into concealment, by some meat-eating mammal or bird, to which, even when "high," they are palatable. But a shrew, as previously stated, almost immediately becomes so unpleasantly putrid, that no animal, unless exceptionally hungry, cares to touch it.

Everyone has met with cases where rabbits and rats are found surviving, and in a fair way to recover from, extremely severe wounds; for instance, it is nothing uncommon to find a rat suffering from a suppurating wound caused by a stab from a pitchfork. Among many other cases may be mentioned a rabbit quite recently killed near Henley-on-Thames during the cutting of a field of oats, which had evidently, several days previously, lost three of its legs by the knives of a binder. It was quite lively, and not at all meaning to die, but there is no doubt that a far less proportionate injury would be instantly fatal to shrews.

Further light is undoubtedly thrown on the whole matter by the studies of Mr Adams, who concludes that the entire adult shrew population perishes each autumn. The evidence in support of this conclusion, which has recently been published, is based on examination of specimens throughout the year, and is so strong as to be nearly incontrovertible. It has further been supported by numerous more recent, and

still unpublished, observations by Mr Adams, all of which he has most kindly placed at my disposal. Amongst forty-eight Pygmy and three hundred and ten Common Shrews captured after December, there was not a single adult of either sex, and not a single female that had already bred. Consequently, according to Mr Adams, the autumnal "epidemic" is due to nothing more than old age; old age in the case of the Common and Lesser Shrew being reached in, roughly, thirteen or fourteen months.¹

To show that the proportions of adults and juveniles actually vary definitely according to season, Mr Adams has prepared a table showing the average size of shrews throughout the year. This has been summarised above on page 92, and bears out his conclusions in a very remarkable manner.

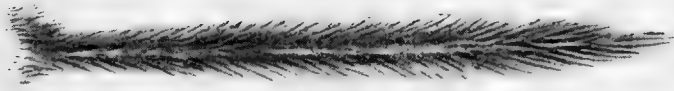
On the whole, it seems that there is probably more than one cause of mortality. It is not restricted to any one of our three British species. It may be, however, connected with the breeding season, and occasionally, at least, with some bad-tempered but not hungry assailant. Add to the above the known pugnacity and fragility of all three species, so well illustrated by the late John Cordeaux's observation of two male Water Shrews which fell in mortal combat and yet showed hardly a trace of their encounter,² and we have a handful of causes, any one of which—and there may be many others—might answer for many deaths, and that specially in summer when the countryside is crowded with young shrews all newly launched upon a thickly-populated world, and ready victims in the struggle for existence amidst the changing conditions of food supply and atmosphere.

A remarkable feature of the natural history of the present species is its, at least occasional, habit of congregating in numbers on one small area. Thus, Mr W. N. McCartney, more than thirty years ago, recorded³ his observation in May of "between one hundred and one hundred and fifty shrew mice running nimbly about, uttering their peculiar sharp cry . . .

¹ See "A Hypothesis as to the cause of the Autumnal Epidemic of the Common and the Lesser Shrew, with some Notes on their Habits," in *Mem. and Proc. Manchester Lit. and Philosoph. Soc.*, liv., 10, 1-13 and plate, read 8th February 1910; also comments by C. B. Moffat, *Irish Naturalist*, 1910, 121-126.

² See below under Water Shrew.

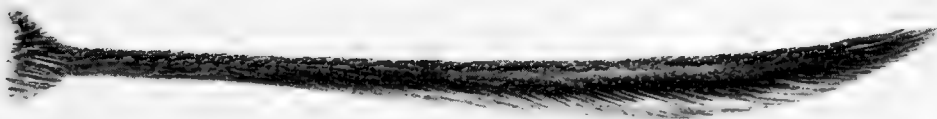
³ *Zoologist*, 1861, 7624.



(1)



(2)



(3)

TAILS OF (1) LESSER SHREW, (2) COMMON SHREW, AND (3) WATER SHREW.
(All viewed from side ; magnified $1\frac{1}{2}$ times.)

chasing and calling on one another." Again, Mr F. Longman has recently recorded a congregation estimated to include nearly one hundred shrews.¹

There is some evidence that shrews occasionally, at least, combine to travel and hunt their prey in "packs," after the fashion of the stoats and weasels. Mr H. J. Charbonnier, for instance, has observed the present species travelling in small parties of eight or ten, the individuals scattered over a few yards, but all heading in one direction, and a similar record is that of the late Canon H. B. Tristram,² who met with nine or ten Water Shrews hunting on the path of a plantation, a mile from water, and it can hardly be doubted that these were family parties of parents and offspring.

It cannot be denied that the habits of the Common Shrew render it an animal beneficial to the farmer and gardener, and in every way worthy of protection.

THE PYGMY OR LESSER SHREW.

SOREX MINUTUS, Linnæus.

1766. *SOREX MINUTUS*, Carolus Linnæus, *Systema Naturæ*, xii., 73 ; described from Jenesei River, Siberia ; Alston, *Fauna of Scotland*, 1880, 10 ; Thomas, *Zoologist*, 1895, 43 ; Lydekker ; Beddard ; Johnston ; Millais ; Trouessart (1910) ; Collett.
1769. *SOREX PYGMÆUS*, Erich Laxmann, *Sibirische Briefe*, 72 (ed. Schlözer) ; described from Barnaul, Tomsk, Western Siberia, 17th November 1764 ; Pallas, *Zoographia Rosso-Asiatica*, i., 134-135, tab. x., fig. 4, 1811 ; Blasius ; Fatio ; Bell (ed. 2) ; Woodward and Sherborn ; Flower and Lydekker ; Winge.
1774. (?) *SOREX PUSILLUS*, S. G. Gmelin, *Reise durch Russland*, iii., 499, tab. lvii., fig. 1 ; described from Persia ; Zimmermann, *Geographische Geschichte des Menschen*, etc., 1780, ii., 385, sp. 317 ; Blanford, *Eastern Persia*, 1876, ii., 25-26.
1780. *SOREX MINUTISSIMUS*, E. A. W. Zimmermann, *op. cit.*, 385, sp. 319.
1788. (?) *SOREX CÆCUTIENS*, Erich Laxmann, *Nova Acta Acad. Sci. Imp.* (St Petersburg), iii., 285, 12th May 1785 ; described from Lake Baikal ; = *S. pygmæus* of Pallas ; see Pallas, *loc. cit.*, *supra*.
1788. (?) *SOREX EXILIS*, J. F. Gmelin, *Systema Naturæ*, i., ed. 13, 115, sp. 11 ; described from the Jenesei River, Siberia.
1806. *SOREX CANALICULATUS*, S. I. Ljungh, *Kongl. Vetenskaps Akademiens Nya Handlingar* (Stockholm), xxvii., 263 ; described from Lommaryd Vicarage, Northern Vedbö district, Jönköping, Sweden.
1811. (?) *SOREX GMELINI*, P. S. Pallas, *Zoographia Rosso-Asiatica*, i., 134, tab. x., fig. 3 ; renaming *S. pusillus* of S. G. Gmelin from Persia ; Blanford, *op. cit.*, 1876, 26.

¹ *Field*, 4th July 1908, 4.

² *Zoologist*, 1853, 3905.

1811. SOREX MINIMUS, Isidore Geoffroy, *Ann. du Mus. d'Hist. Nat.* (Paris), xvii., 186; renaming *S. minutus* of Linnæus.
1832. (?) SOREX PUMILIO, J. Wagler, Oken's *Isis* (Jena), 54; described from Bavaria; see Nathusius in Weigmann's *Archiv für Naturgeschichte*, 1838, i., 19-47.
1838. SOREX RUSTICUS, Leonard Jenyns, *Ann. Nat. Hist.*, i., 423; described from England; MacGillivray, appendix, in error.
1838. SOREX RUSTICUS, var. β , *S. HIBERNICUS*, Leonard Jenyns, *loc. cit.*; described from Dublin, Ireland.
1842. AMPHISOREX PYGMÆUS, G. L. Duvernoy, Guérin's *Mag. de Zool.*, 30, pl. 48.
1843. CORSIRA RUSTICA, J. E. Gray, *List of the Specimens of Mammalia in the Collection of the British Museum*, 79; Abbey, *The Balance of Nature*, 1909, 5.
1844. SOREX PUMILUS, S. Nilsson, *Öfversigt af Kongl. Vetenskaps-Akad. förhandlingar* (Stockholm), i., 33, 20th March; described from North-Eastern Skaane, Sweden.
1890. HOMALURUS PYGMÆUS, E. Schultz, *Schriften des Naturwissenschaftlichen Vereins des Harzes* (Wernigerode), v., 28.

La Musaraigne pygmée of the French; *die Zwergspitzmaus* of the Germans.

The plan of the **synonymy**, which is comparatively simple, is similar to that of *S. araneus*. *Minutus*, although overlooked until recent years, is undoubtedly the correct name for the European Pygmy Shrew,¹ at least until such time as the Pygmy Shrew of the Jenesei district may be shown to be distinct. Of the remaining names, some are pure synonyms, while others may prove to be applicable to local races or even to distinct species; *cæcutiens* was pronounced by Pallas, who examined Laxmann's specimens, to be identical with *pygmæus*, while *pumilio* has been similarly placed by Nathusius; *rusticus* and *hibernicus* were bestowed respectively upon the Pygmy Shrews of England and Ireland by Jenyns in days when these animals were very little known to naturalists. The species was well discussed by Gloger in 1827, *Nov. Act. Phys-Med. Acad. Cæs. Leop. Nat. Cur.* (Bonn), 483-498, coloured plate xxv. It first appeared in its proper status as a British mammal in Bell's second edition, the account of it which appeared in that work having been written by E. R. Alston. Further details of its history will be found below on pp. 116-117.

Local names:—See above, under Common Shrew, p. 85. Grass-mouse of Co. Fermanagh, Ireland (see Adams, *Zoologist*, 1906, 439; rone (=thicket) -mouse (see *Dial. Dict.*) of Orkney (Moodie Heddle).

Distribution:—The range of *S. minutus* is as yet imperfectly known, but it is found certainly throughout arctic, boreal, and transitional Europe, from sea-level to at least 5500 feet, as in Transylvania; and from Ireland eastwards to the Altai (Kashtchenko), and the shores of the Pacific, including Korea, Kamchatka, Hondo, and

¹ For a further explanation, see below, p. 117.

Sakhalin. In Skandinavia it is less numerous than *S. araneus*, but inhabits all parts of Norway as far north as the Varangerfjord ($70^{\circ} 5' \text{ N. lat.}$), and ascends the mountains to the tree limit (Collett). It reaches at least 61° north latitude in Russia (Blasius); and according to Dobson, *Proc. Zool. Soc.* (London), 1891, 350, has been found within the Arctic circle at the Khatanga and Olenek rivers, in Siberia. Southwards it ranges to the Pyrenees (*not* in Spain, Cabrera), southern Italy (but not in the Balkan Peninsula, *fide* Miller), the (?)Crimea, the regions around the Lower Volga, (?)Persia (Mazandarán, Derband, etc.), and (?)Lake Baikal. It would appear to be everywhere less abundant and more sporadic than *S. araneus*; thus Blasius states that in Germany, of 200 shrews only 20 were *minutus*, or 9 *araneus* to 1 *minutus*; for Norway, Collett gives the corresponding figures as 210 and 7, or 30 *araneus* to 1 *minutus*; and Adams for a small district near Reigate, as 210 and 40, or 5.25 *araneus* to 1 *minutus*. The animal is so unevenly distributed that in a second district near Reigate the figures would be, according to Adams, 210 and 0, while those for specimens taken from owl pellets collected in many parts of England are 344 and 27, or nearly 13 *araneus* to 1 *minutus*, the latter item being considered by him too high for an average ratio throughout the country.

It is directly represented in America by the hardly distinguishable *S. personatus* of I. Geoffroy and allied forms, which are widely distributed from ocean to ocean in arctic, boreal, and transitional zones.

The Pygmy Shrew is probably of as wide distribution throughout the mainland of **Britain** as the previous species, but, as in continental Europe, it appears to be, as a rule, far less numerous, though its numbers seem to vary locally. Thus, although generally reputed to be rare, in certain of the hill cloughs of Cheshire it is as abundant as, or more so than, *S. araneus* (Coward, *in lit.*). It is common about Edinburgh, especially, as W. Evans believes, in the moorland districts, but Booth (*Zoologist*, 1911, 314) insists on its rarity in Yorkshire. It is of wide range amongst the islands, being the only shrew of **Ireland**, where it occurs in every county and on Clare, Rathlin (Adams, MS.), and Achill Islands (specimens in Dublin Museum caught by Alexander Williams); Man; the Outer Hebrides; and Orkneys. I have seen specimens, many taken by Kinnear, from Lewis, North Uist, Benbecula, South Uist, and Barra, indicating a very wide distribution in these islands; while in the Orkneys shrew mice were mentioned by Barry (1805) as found "but rarely," but were not properly identified until 1905, when Eagle Clarke trapped specimens at Stromness in Mainland (*Ann. Scott. Nat. Hist.*, 1905, 8); it is common at least in that island and South Ronaldshay, where it has been taken also by Godfrey and by Kinnear.

In the Inner Hebrides it is known at least from Skye (Steele Elliott); Eigg (Harvie-Brown and Buckley); Tiree (Eagle Clarke, *Ann. Scott. Nat. Hist.*, 1898, 111); Sanda and Great Cumbrae (Boyd Watt); and Ailsa Craig (Kinneir, *Ann. Scott. Nat. Hist.*, 1907, 49). In the English Islands it is known from Anglesey (Coward); Wight (Wadham, Thomas); Scilly (Chubb); and Lundy; in the latter it is probably numerous, specimens having been shown me by Joy and by Coward and Oldham (see Coward, *Mem. and Proc., Manchester Lit. and Philosoph. Soc.*, lii., i., No. 6, 3-4, 10th December 1907, published 22nd January 1908).

It frequents the highest mountains of Britain to their summits, having been taken at the observatory on Ben Nevis, at an altitude of some 4400 feet (Feilden, *Ann. Scott. Nat. Hist.*, 1897, 42); on Longmynd, Shropshire, at over 1500 (Forrest, MS.); and in Coiynafearn deer forest, Inverness-shire, at 2000 feet (C. H. Alston, *Ann. Scott. Nat. Hist.*, 1909, 114).

Distribution in time and status:—Judging by its distribution, the Pygmy is an older species in Britain than the Common Shrew; but this is not as yet borne out by the facts at present available regarding its history in past geological times; for it is only known in Britain from the latest pleistocene deposits (Ightham fissures). The remains from the late pliocene Forest-Bed and other old deposits formerly assigned to it belong, as Hinton has shown, to extinct forms, and have nothing to do with *S. minutus*. In its dentition, its lesser size and its more elongated body, it seems to be more specialised than *S. araneus*; but its comparatively low plasticity—since it ranges in almost indistinguishable form throughout a vast area of continental Europe, Asia, and America—and the fact that it wears throughout life a pelage corresponding to that of the juvenile Common Shrew, certainly point to a more ancient species.

Description:—Although in general structure and appearance the Pygmy Shrew at first sight closely resembles the preceding species, it is smaller, relatively longer, as well as more finely built; has a longer, thicker, more hairy tail; the feet more slender, the outer toes longer and more heavily haired; and the snout more heavily moustached (whiskers reaching 16 millimetres), as well as relatively longer and thicker. The seasonal changes of colour and length of the fur are not nearly so marked as in *S. araneus*.

In the **hand and foot** the tip of the first digit reaches beyond the pad at the base of the second, and the tip of the fifth about half-way to the tip of the fourth (compare *S. araneus*, above, p. 87, and see Plate VIII., Figs. 1 and 2).

The **colour** of the upper side varies in winter between "hair brown" and some ruddier shade; the under side, including the

inner surfaces of the legs and the under surface of the tail, is dirty white, with a moderately sharp line of demarcation passing from the angle of the mouth on each side to the shoulders, and thence along the flanks to the anus. The feet are near "wood brown;" the tail near "prout's brown," lighter beneath. In summer the upper side is of a tint between "drab" and "fawn colour," with the under side yellowish or brownish, lighter on the upper throat. The hidden basal portions of the hairs are always and at all seasons near "blackish slate," or darker.

The above description applies to preserved skins, but in life there is present on the fur an iridescence which leads English to style it as "unquestionably the most beautiful" to be found on a British mammal.

The **moult**s of the winter and summer pelages appear to agree pretty closely with those of the Common Shrew, and there is the same irregularity in regard to date; the hairs of the tail are renewed in summer or autumn, leaving that organ temporarily very bare and the vertebræ prominent. I have seen specimens in this condition from Ireland in September, and others from South Ronaldshay, Orkneys, in August, the latter sent to me by Godfrey. On the other hand, August specimens from South Ronaldshay and Achill Island, Ireland, have the tail thickly haired, but these were probably young of the year, which Adams finds have always hairy tails.

In the much smaller and more fragile **skull** the brain-case is narrower and more elongated than in *S. araneus*; its outline, viewed from above, is distinctly oval, not circular. The unicuspid is characteristic, since they decrease in size with comparative regularity from front to back. Nos. 1, 2, and 3 are nearly equal, 4 is distinctly smaller than 3, and 5 is minute, although usually of relatively larger size and greater external visibility than in *S. araneus*. The posterior molar is large and projects behind the process of the malar bone, whereas in *S. araneus* it is so entirely concealed by that bone as to be usually invisible from the outside. In the first upper incisor the posterior lobe is relatively not so thick as in *S. araneus*, the length of its base being about half that of the anterior cusp; and in the first lower incisor the basal lobes do not diminish regularly in diameter from front to back, but the first is as well defined from the anterior point of the tooth as from the second lobe (Fig. 24, No. 2, p. 90); the gap between the first and second is not conspicuously the largest, as it is in *S. araneus*.

This species is much less subject to **individual variation** than *S. araneus*. Merriam and Miller (*North American Fauna*, No. 10, 1895), state that in the American Pygmy Shrew, *S. personatus*, a chestnut pelage or phase occurs, but is rare. This may possibly correspond to

the rufous form of *araneus*, and should be looked for in *minutus*. Again, in some American specimens there is an approach to the tricoloured pattern of *S. araneus*, though not in a very pronounced degree.

Some specimens from Orkney and the north of Scotland are slightly darker than those from Britain generally, but the series of accurately prepared and measured specimens is too slight to form a basis for final conclusions, which must await the accumulation of a sufficient series from British localities.

Exceptional variation and sports:—Of white or albino Pygmy Shrews, one from Thetford, England, is in the possession of Bidwell (Southwell); a second is in J. Whitaker's collection (*Field*, 19th February 1910, 333); a third, a male from Brandon, Suffolk, taken in October 1910, belongs to Dalgliesh (*Zoologist*, 1911, 27). Of three from Ireland, the first, a cream-coloured example of large size, was taken in Kerry in 1840 (Thompson); the second is from Limerick (Daly, *Field*, 21st August 1897, 318); and the third, from Fermanagh, was in the possession of the late Sir Douglas Brooke.

Geographical variation:—The Pygmy Shrew seems to be comparatively lacking in plasticity, but Miller (*Ann. and Mag. Nat. Hist.*, May 1909, 415) has recently described a sub-species, viz., *S. m. lucanius*, from Monte Sirino, Lagonegro, Italy, with enlarged molars and anterior upper incisors. Gmelin's *S. pusillus*, from Persia, and Laxmann's *S. cæcutiens*, from Lake Baikal, may be large forms of *S. minutus*, and the same remark perhaps applies to Pallas's *S. gmelini*, also from Persia, but the description of the latter is so vague that the type specimen may actually have been some form of *Crocidura*. At the other end of the palæarctic region, Thomas's *S. m. gracillimus*, from Sakhalin, described in *Proc. Zool. Soc.* (London), 23rd April 1907, 408, from a fragment of one specimen, is said to present distinct skull characters. The same writer's *S. annexus* of Korea (*Proc. cit.*, 27th November 1906, 859), an animal of the size of *araneus*, and *S. shinto* of Hondo, Japan, a large form with long tail, with a sub-species *S. s. salvus*, larger in body and shorter in tail, in Hokkaido and Sakhalin, are also probably representative. A striking aberration from the type is Miller's *S. macro-pygmaeus* of Kamchatka, which in size agrees with *S. shinto*. In this it seems to carry on the relationship to its nearest geographical neighbour of the group, Merriam's *S. personatus steatori* of Alaska, itself a large form of a type (i.e., *S. personatus*) which, ranging right across the American continent, is directly representative of and barely distinguishable from *S. minutus*. The resemblance is enhanced by the extremely slight tendency shown by *S. personatus* to vary with locality. A pale desert form is, however, known.

DIMENSIONS IN MILLIMETRES:—

	SPECIMENS MEASURED IN THE FLESH.				Weight in grammes.	
	Head and body. ¹	Tail without terminal hairs.	Hind foot without claws.	Ear.		
MALES.						
One, Skye, Inner Hebrides (J. Steele Elliott)	55	36	10	..	..
One, Stornoway, Lewis, Outer Hebrides (Colonel Hawker)	47 (?)	38	11	..	..
One, Barra, Outer Hebrides, 21st May (N. B. Kinnear)	66	39	11	6·5	..	
One, North Uist, Outer Hebrides, 13th June (N. B. Kinnear)	60	38	10	..	..
One, North Uist, Outer Hebrides, 28th June	55	41·5	11	6	..	
One, South Uist, Outer Hebrides, 1st June	58	37	10·5	6·5	..	
Two, Orkney, 26th and 30th May (N. B. Kinnear)	{ 56·5 58	{ 36 38	{ 11 11	{	{ 4·73 4·54	
Six, Orkney and Outer Hebrides (N. B. Kinnear), average	58·9	38·25	10·75	6·33	..	
Twenty-eight, Reigate, Surrey (measured by L. E. Adams)	Maximum 63	42	11·5*	7†	5‡	
	Average 56·6	39·4	10·8	6·7	5	
	Minimum 49	36	10	6	4·5	
FEMALES.						
One, Dalmeny, Linlithgowshire, Scotland, 4th January (N. B. Kinnear)	48	38·5	10·5	5	..	
One, North Uist, Outer Hebrides, 19th June	55	..	10·5	6·5	..	
One, Lewis, Outer Hebrides, 5th July	60·5	38·5	10	6·5	..	
Six, Orkney (N. B. Kinnear)	28th May	37	11	..	4·03	
	30th "	59	35·5	10	..	4·41
	31st "	56	38	11	..	{ 5·79 (contained 6 embryos) 3·2
	9th Oct.	50	35·5	11	5·5	
	17th Nov.	53 and 54	36 and 41	11 and 11	4·5 and 4·5	
Six, Orkney; two, Outer Hebrides; and one, Scotland (N. B. Kinnear), average	54·38	37·5	10·66	5·41	..	
Twenty-four, Reigate, Surrey (measured by L. E. Adams)	Maximum 62	45	11	7	6·1	
	Average 56·5	40	10·8	6·7§	4·6||	
	Minimum 52	31	10	6	3	
SEX UNKNOWN.						
Sixteen, English and Welsh, dimensions from labels, average	64	37	10 to 11	6 to 7	..	
Six, Scotland, average	51·75	40·5	10 to 11	6	3·65 (W. E. Clarke)	
One, Lundy Island (Coward and Oldham)	55	41	11·5	..	..
One, Benbecula, Outer Hebrides (N. B. Kinnear)	60·5	38	10	6	..	
One, Barra, Outer Hebrides (W. E. de Winton)	56	34	11	..	..
Eight, Isle of Man (taken and measured by C. H. B. Grant)	59·6	40	11·1	6·4	..	
Ten, Ireland, average	59·3	36·2	10·95	..	..

¹ The snout may project 6 mm. beyond the incisors, which makes the head of a shrew proportionately long as compared with that of most other mammals.
* Once only. † 4 items only. ‡ 7 items only. § 3 items only. || 7 items only.

There is no evidence to show that there is any constant sexual difference in dimensions. The most accurate measurements are those

to which the names of the collectors are appended. Kinnear took a pair of scales to Orkney with the express purpose of weighing this mammal.

Skull:—Greatest length, 16; basal length in middle line, 13; palatal length in middle line, 6; length of upper tooth-series, 6.5; ditto of lower, 6; greatest breadth, 7 to 7.8; breadth at constriction, 2.5 to 3.

Proportionate lengths:—Tail (without end hairs), about .65 to .7 of head and body; hind foot about .17 to .18, and ear about .1 of head and body.

The **weight**, when compared with that of the Common Shrew, shows that the Pygmy is a much lighter animal in proportion to its dimensions even than the measurements would suggest. Nine weighed by Adams in October 1910 averaged 5, with maximum of 6 and minimum of 4.2 grammes. The weight therefore is to the head and body length as 1 to 11, whereas in *S. araneus* it is about as 1 to 6; so that the average weight of each millimetre of head and body length is only .11 as against .6 grammes in *S. araneus*.

Adams finds that the weights and dimensions undergo a seasonal variation corresponding to that of the Common Shrew. He finds also that in such tiny animals the weight is seriously affected by the emptiness or fullness of the stomach, and even more so by advanced pregnancy.

The distinguishing characters have been given in some detail in the description. The smaller size, especially that of the foot, longer and thicker nose and tail, plainer coloration, and the size and pattern of the teeth are the most conspicuous.

The Lesser or Pygmy Shrew has until now been classed as the tiniest of British mammals, and in fact it is one of the smallest of the whole class. It is more minute than the Harvest-mouse, and even on the European continent only one non-volant mammal, also a shrew,¹ is more diminutive. It appears, however, that its weight is about the same as, or greater than, that of some of the smaller bats, such as the Pipistrelle, and possibly also the Whiskered. But the point must be left undecided until more accurate information becomes available. The extreme length of its body is no less characteristic than its diminutive size.

It is probably due to its small size that the Pygmy Shrew for so long escaped the attention of British naturalists. It was generally mistaken for the young of its larger congener, so that

¹ *Pachyura etrusca* (Savi).

it remained until recently one of the least known of our terrestrial mammals, excepting only certain species of bats. All the earlier writers, such as Pennant, Bingley, Donovan, Fleming, Bell,¹ and MacGillivray enumerate but two species of shrew, of which one was the Water, the other a composite species compounded of the Common and Pygmy Shrews. The truth had escaped the notice of Jenyns, one of the wisest of early British mammalogists, when he wrote his *Manual*, but eventually he recognised two terrestrial species, the smaller of which he characterised as *Sorex rusticus*. No other course was possible under the circumstances, since there was at that time no available means of comparing British with continental specimens. At the same time Jenyns bestowed upon an Irish specimen the name of *Sorex hibernicus*, but his description, having been evidently based upon a comparison of an Irish Pygmy with an English Common Shrew, was founded upon insufficient basis, as he himself eventually admitted. It was left to Blasius in 1857 to express the conviction that the *S. rusticus* of Jenyns was identical with the *S. pygmæus* of Pallas, a conviction verified by the editors of Bell's second edition, who, by the kindness of the late Professor Alfred Newton, were enabled to examine Jenyns's typical specimen, presented by him to the University Museum of Zoology at Cambridge. Later researches have shown the probable identity of Pallas's *S. pygmæus* with the *S. minutus* of Linnæus, and the latter is accordingly the correct technical name for the Pygmy Shrew.

Even of late years our knowledge of this tiny species has accumulated very slowly, and it only took its place in Bell's second edition by the medium of a single sheet, written by E. R. Alston, and issued after the completion of the rest of the work. But, only a few years previously, Alston, judging by a note which he wrote in 1865² on the subject, seems to have been uncertain about it. Its name was absent from reputable local faunas of so late a date as Mr H. E. Forrest's *Shropshire* (1899), George Sim's *Dee* (1903), and Mr David Bruce's *Mammalia of Caithness* (1907). It was only added to the Fauna of Staffordshire in 1885, of the Edinburgh district in

¹ First edition.

² *Zoologist*, 1865, 9430.

1889, of Cheshire in 1894, and of Shropshire in 1900.¹ In fact, until the present era of systematic trapping it was universally regarded by naturalists as a much more valuable prize than it is now known to be, which is not surprising in view of the fact that in those days practically all the shrews which came to hand were provided either by the accidents of æstival mortality or by the unguided forays of the domestic cat.

In its habits, so far as our scanty knowledge goes, the Pygmy does not differ widely from the Common Shrew; it may be taken with the same traps and baits, in the same runs, and in the same localities, at all seasons and in every state of the weather. There is one, for instance, in the British Museum, which was caught by Mr R. J. Cunninghame in a Skandinavian forest, at an altitude of 1900 feet, on 15th January 1895, the trap having been placed on two feet of snow and the thermometer standing at zero. It is, if anything, of more extensive distribution than the larger species, occurring, as it does, from sea-level to the tops of our highest mountains, having been found in Scotland on a snow-patch at 2000 feet at least,² as well as at the summit of Ben Nevis (4400 feet), and on many desolate islands where the larger species is absent. Some writers state that, although not restricted to any particular haunts, it prefers wooded localities. Messrs G. H. Caton Haigh³ and Lionel E. Adams⁴ have nearly always found it in woods, but William Thompson particularly noted its occurrence on the loftiest of the Irish mountain-tops, "where these are clothed with verdure." It is evidently, as might be expected from its slender feet and long outer toes, an excellent climber, and one was found in a room in the upper storey of my home in Ireland, where, having ascended the curtains, it proceeded to draw so much attention to itself by its constant squeaking that it was thought to be something uncanny, and was shot. Another instance of this shrew having entered a house in county Galway was communicated to me by Mr R. F. Hibbert. But this is a common practice with shrews in the

¹ Forrest, MS.

³ MS.

² C. H. Alston, *Ann. Scott. Nat. Hist.*, 1909, 114.

⁴ *Zoologist*, 1906, 439.

North, as in Norway, where, according to Professor Robert Collett, the present species attacks meat and tallow.

Blasius remarks that it is not so often seen abroad during the day as is its larger congener. But it is equally subject to a mysterious seasonal mortality, in regard to which the late Dr R. J. Burkitt wrote me that on a fine summer day he counted nine lying dead, but apparently unmauled, on his lawn at Rocklands, Waterford, in county Kilkenny; Mr J. G. Millais finds the same mortality in North Uist.

Until quite recent years there was no definite information available about the breeding habits of this shrew. The observations quoted below show, however, that the young may vary from two to eight, and that they are born at various dates between early May and September, so that probably the females produce at least two litters each summer. In the south the breeding season may be even longer, since Mr Edwin Hollis has sent me a note of a Devonshire female containing two quite small embryos on 26th February.¹ As regards other records, Mr Adams² found eight embryos on 5th May, while I received a female suckling young from Mr John Hunter of county Wicklow on 16th May, and another from county Galway on 6th June, in which month Mr Adams found two lots of five and six respectively, and Mr R. Patterson found eight embryos near Belfast; Professor H. Lyster Jameson found seven in Ireland on 28th June, and five well developed in county Louth on 7th July;³ and in August Mr N. B. Kinnear found six in Orkney, and Mr Oxley Grabham five nearly ready for birth in Yorkshire.⁴

So far as I am aware, the first published description of the nursery of the Pygmy Shrew was that of Mr Millais, who met with one in North Uist in August 1899. It was "a small compact ball of dried grass interwoven and interlaced on the top with some of the fine rushes in which the nest was built. It contained five young ones about three parts grown. When held in the hand they appeared to be almost blind, and did not

¹ See also description of supposed nursery in Clare Island on 1st March, below, p. 120.

² *Irish Naturalist*, 1902, 176.

³ Both in the Dublin Museum.

⁴ *Zoologist*, 1895, 427.

make any attempt to get away. In fact, I think the young of both this species and the Common Shrew remain in the nest or its close vicinity until quite full grown."

Another nursery, found by Dr N. H. Joy, contained a similar number of young, laid on chips of wood in a cavity in a rotten stump. A nest, which was probably a breeding one, was shown to me on Clare Island, Ireland, by Mr J. J. M'Cabe, in April 1909; at that time it was deserted, having been disturbed by a man on 1st March. Happening to lift up a slab of stone lying in a grass field, he found under it, in a cavity—apparently excavated—a ball of dry cut grass, from which at least eight or nine shrews ran out. Beside the cavity, there was at the time of my inspection a short blind burrow, about an inch in diameter, in which were some wood-lice and a slug. The nest cavity was connected with the outer world by a burrow leading for a distance of a few inches to the edge of the slab. Mr Adams has sent me details of three other Irish nests. One, found under a large stone at Rathlin Island, in May 1897, was composed of moss and fine grass. The other two, constructed of dried grass only, were placed at the foot of walls at Ballycastle, county Antrim. The situation of the nests suggests that the animal makes no burrow, but utilises existing hollows.

A Pygmy Shrew was taken alive in county Wexford, from a similar nest of dried grass, in a cavity of a loose-stone wall. It showed neither fear nor ill-will, and fed freely on spiders, flies, and wood-lice, darting about after them with great activity. It seemed to make much use of its long, trunk-like nose, which was its most noticeable feature, and which continually quivered and trembled with the utmost flexibility. Worms seemed to be too large for it, and a big spider defended itself with success from all attacks. Smaller insects were seized without apparent method and munched rapidly, and certainly not less than seven or eight were consumed one after the other. For its provision at night a number of wood-lice were caught and placed in its box, and by morning all except one had been eaten, and the shrew lay dead, probably from want of water. In the midst of all its activity the little beast took constant short naps.

histories of very many others, which were formerly little known, have been fully elucidated, while, speaking generally, an immense increase in our knowledge on such important subjects as Migration, Distribution, Habits, Nidification, Plumages, has accrued: And lastly, a new and important branch of study has been instituted—namely, the recognition of the various Racial Forms or Sub-species exhibited by certain birds in the British Islands, on the Continent, and elsewhere.

A great advance has also been made towards a more satisfactory system of classification of the Aves—always a difficult subject—and this necessitates departures from the older views.

To bring this Standard Work thoroughly abreast of the most recent knowledge in all these departments is the object of the present work.

It should be remarked that while it is not intended to go fully into Synonymy, yet, where changes of nomenclature have been necessary in order to conform with the Law of Priority—the only method by which complete uniformity in nomenclature can ultimately be attained—the names used in the Fourth Edition of Yarrell's "British Birds" and in Saunders' "Manual," and the Trinomial Names of the British Racial Forms, and of those occurring in Britain as visitors from the Continent, will be quoted, as will also the Original Name under which the species was described.

In requesting Mr Eagle Clarke to undertake the duties of Editorship, the Publishers desire to make it known that they are acting under the advice of the late Mr Howard Saunders, who placed all his collected notes for a New Edition at Mr Eagle Clarke's disposal for this purpose. That Mr Eagle Clarke is eminently fitted for the work is well known to all who are interested in ornithological science. Through his investigations of the subject, and contributions to its literature, he has long been recognised as one of the foremost authorities on all that relates to British birds. He has studied our native birds in many portions of the British Islands, and has visited a number of bird-haunts in various parts of Europe in order to become acquainted in their Continental homes with the visitants that seek our shores.

On the important matter of the Migrations performed by British Birds, Mr Eagle Clarke's knowledge is unrivalled—a material fact, when it is called to mind how little has been said on this most important subject in any published History of British Birds.

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BY WILLIAM EAGLE CLARKE, F.R.S.E., F.L.S.

Member of the British Association Committee on the Migration of Birds as
Observed on the British and Irish Coasts, and Author of its Final
Reports, 1896-1903, etc.

With Numerous Illustrations and Maps

WITH the exception of the two initial chapters, this work is entirely original, being the result of the author's investigations and personal experiences. These have extended over many years, during which exceptional opportunities have been enjoyed for acquiring knowledge on Bird-migration generally, and its British aspects in particular.

In 1884 Mr Eagle Clarke was elected a member of the British Association Committee on the Migration of Birds as observed on the British Coasts; and on the completion of that great enquiry, he was requested by his colleagues to prepare the final reports on the results obtained—a difficult and arduous task, which he accomplished in 1903.

During the preparation of these reports (five in number), Mr Eagle Clarke became much impressed with the advantages which were likely to accrue from placing a trained ornithologist at a number of the most favourably situated observing-stations around our coasts. If this could be done, he believed that some of the difficulties which the phenomena presented might be solved, and our knowledge regarding the subject generally considerably advanced.

This conviction led him to undertake, by the special permission of the Elder Brethren of the Trinity House and the Commissioners of Northern Lighthouses, a series of personal investigations at various light-stations, each of which was selected for a special purpose. In all, Mr Eagle Clarke has resided no fewer than forty-two weeks in these isolated and remote observatories; the stations visited being the Eddystone Lighthouse, the Kentish Knock Lightship (33 miles off the Essex coast), the lighthouses on the Flannan Isles and Suleskerry (both lying far out in the Atlantic), and the lighthouse at Fair Isle (the "British Heligoland"). He also visited the Island of Ushant—an important station—and Alderney for similar purposes; and spent a month or more in the autumn of 1910 at St Kilda, for the purpose of carrying the investigations to the outmost fringe of the British area.

With these unrivalled experiences for its foundations, the book should not only prove a valuable contribution to the subject of Bird-Migration, but should occupy a place essentially its own in ornithological literature.

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A HISTORY OF BRITISH MAMMALS

BY

GERALD E. H. BARRETT-HAMILTON

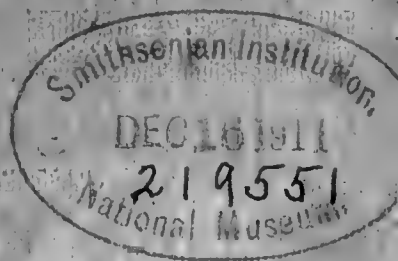
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*WITH TWENTY-SEVEN FULL-PAGE PLATES IN COLOUR, FIFTY-FOUR IN
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1911

Part X. will be published on 2nd January 1912

A NEW AND REVISED EDITION OF
YARRELL, NEWTON, AND SAUNDERS'

HISTORY OF BRITISH BIRDS

EDITED BY

WILLIAM EAGLE CLARKE, F.R.S.E., F.L.S.

Keeper of the Natural History Department, The Royal Scottish Museum; Member of the British Association Committee on the Migration of Birds as Observed on the British and Irish Coasts; Corresponding Fellow of the American Ornithologists' Union;

Correspondirender Mitglied des Ornithologischen Vereins in Wien;

Membre Honoraire du Bureau Central Ornithologique Hongrois;

Member of the British Ornithologists' Union, etc.

ILLUSTRATED BY ORIGINAL COLOURED PLATES OF EACH SPECIES
SPECIALLY EXECUTED BY

MISS LILIAN MEDLAND

THE publication of Yarrell's "History of British Birds" was commenced in 1837 and completed in 1843. Its outstanding merits were at once recognised, and a Second Edition was called for in 1845, followed by a third in 1856.

From the issue of the Original Edition down to the present day, Yarrell's "History of British Birds" has generally and deservedly been regarded as the standard authority on British ornithology.

In the year 1871 a Fourth Edition was begun, under the masterly editorship of Professor Newton—the greatest British ornithologist of all time. Unfortunately Professor Newton's official engagements at the University of Cambridge only allowed him to complete the first two volumes; and in 1882 Mr Howard Saunders was selected to edit the remaining volumes, a task which he successfully accomplished to the entire satisfaction of ornithologists in 1885.

The many excellences of this last edition advanced the work more than ever in the public and in scientific favour. To its stimulating influence is to be mainly attributed the marvellous and unprecedented activity which has resulted in those extraordinary advances made in all branches of British ornithology during recent years—advances which have rendered it essential that a new work based upon this classical and comprehensive foundation should be issued.

During the period alluded to, a considerable number of new and interesting species have been added to our avifauna. The

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SORICIDÆ (Shrews)—

Genus *Sorex*—

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The English local names have been revised in part by Mr W. W. Skeat, M.A. (assisted by Professor W. W. Skeat), and in part by Mr C. M. Drennan, M.A. Lond., late Scholar Emm. Coll. Camb.; the Celtic and Gaelic names by Dr E. S. Quiggin, M.A., Ph.D., Fellow and Lecturer in Modern Languages and Celtic of Gonville and Caius College, Cambridge; while a list of Scottish Gaelic names have been supplied by Mr C. H. Alston. Valuable assistance has been rendered by Mr M. C. A. Hinton regarding extinct Mammals.

ILLUSTRATIONS

FULL-PAGE (*Coloured and Black and White*).

The Stoat. (*Coloured*.)

Heads (viewed from side) of—(1) Lesser Shrew; (2) Common Shrew; and (3) Water Shrew.

Heads (viewed from above) of—(1) Lesser Shrew; (2) Common Shrew; and (3) Water Shrew.

Water Shrew—(1) Left Fore Foot from beneath; (2) Left Hind Foot from side; and (3) Left Hind Foot from beneath.

FIGURES IN TEXT.

Skulls of (1) *Sorex araneus* and (2) *S. minutus*—(a) from above; (b) from the side.

Skull of *Neomys fodiens*—(a) from above; (b) from the side; (c) from beneath.

Skull of *Talpa europæa*—(a) from above; (b) from the side; (c) from beneath.

Skull of *Epimys rattus*, to show "rodent teeth" (life size).

Upper Cheek Teeth of *Duplicidentata*.

Skull of *Ochotona spelæa*, from Kent's Hole, Devon.

Regarding the care of shrews in captivity, Mr A. H. Cocks writes me that he knows of no practical way of trapping them alive, for though they will probably go into almost any form of live trap, a few minutes' detention therein is fatal, in a ratio varying with the size of the species.

"Pygmy Shrews I have never kept alive, because the transit from field to cage in a man's hand, even if it is only a few hundred yards, is either immediately fatal, or is so within the next hour or two. I frequently provide a tin with ventilation holes punched, when hay or other field work is in progress (especially when mangolds or swedes are being taken from a clamp), but no shrew is caught that day, or the next, and when at last one is captured, the tin is not forthcoming.

"With Common Shrews, which are so very much more numerous, as well as stronger, I do from time to time get one alive into a cage, but a rather large proportion die during the ensuing night. I have been careless in noting dates of arrival, but three months is probably about the extent to which one has lived.

"Insectivores, like nearly all other mammals, require to drink a good deal, and should invariably have a supply of water in captivity.

"As regards food, shrews, like moles, to which they are very similar, have an extraordinarily rapid digestion, and therefore require to eat at short intervals. A handful of worms twice a day suffices, because they disable each worm in turn, preventing it from crawling away by biting it along its whole length, and then bury it in the moss or other vegetable nesting-material provided, whence they excavate their helpless victims and devour them as appetite demands."

From the above notes, compared with those of other naturalists who have captured and kept the Common Shrew alive, it may be inferred that, although so indefatigable in pursuit of their prey, the intelligence of the shrews is not of a very high order.

It is evident that the snout is the seat of specially strong organs of sense, enabling the little animals to secure their often agile prey by scent, without the assistance of the tiny eyes.¹

¹ Since the above was written, Adams has specially studied the eyesight of a captive Common Shrew, and reports that it is "as blind as the mole," thus confirming Ernest Thompson Seton's poor opinion (ii., 1100) of the eyesight of American shrews.

It seems clear also that the creatures preyed upon by the Pygmy Shrew are, owing to its puny size, necessarily smaller and weaker than those attacked by the Common Shrew. But it is a bold forager, and according to Professor Collett, in Norway it sometimes searches out the nests of ground-wasps and devours the larvæ. If its appetite throughout the winter is such as the behaviour of my own captive would suggest, I am filled with wonder to know how it can obtain food in sufficient quantities.

The same idea occurring to Dr C. Hart Merriam¹ (in regard, of course, to the North American sub-species), made him conclude, although without direct evidence, that the "diet is more comprehensive than most writers suppose, and that they feed upon beechnuts and a variety of seeds,² and possibly roots as well." Of three which he placed together, "in less than eight hours one of these tiny beasts had attacked, overcome, and ravenously consumed two of its own species, each as large and heavy as itself."

My own experience of trapping the Pygmy Shrew is that it is unevenly distributed, as it comes to traps in a very uncertain manner. Mr Kinnear, trapping not far from where Alston in 1867 caught several, has never obtained one. Perhaps it is scattered over the country in small colonies, after the fashion of the Water Shrew, and this may account for the fact that, while in one locality it is accounted rare, in another it is abundant. There is, for instance, a dry roadside bank by a plantation in the county Wexford, overgrown with whitethorns, but bare of under-cover, where several were easily caught, while in other situations of like appearance not one could be secured. Similarly, in Germany, during six weeks spent in trapping small mammals on the outskirts of Querum Forest, Brunswick, I never met with a sign of this species until my last day, and then I was rewarded with two, the one caught on the edge of the wood, the other in a grass run in a field just outside.

A point to which Mr C. B. Moffat has drawn attention is that, although it is in Ireland free from the competition of

¹ *Vertebrates of the Adirondack Region*, i., 76-77.

² The Pygmy will come to a bait of cheese (Forrest, MS.).

the larger and more powerful Common Shrew, the present species has not responded by a conspicuous increase in numbers, and it is probably nowhere in that country so abundant as the Wood Mouse.¹

It is remarkable that the Nearctic representatives of the Pygmy Shrew seem to be better known to American naturalists than the forms representing our familiar Common Shrew. Mr Thompson Seton has brought together quite a full account of the habits of the former, which are especially interesting in winter. According to Mr Nelson,² "the first severe weather brings them

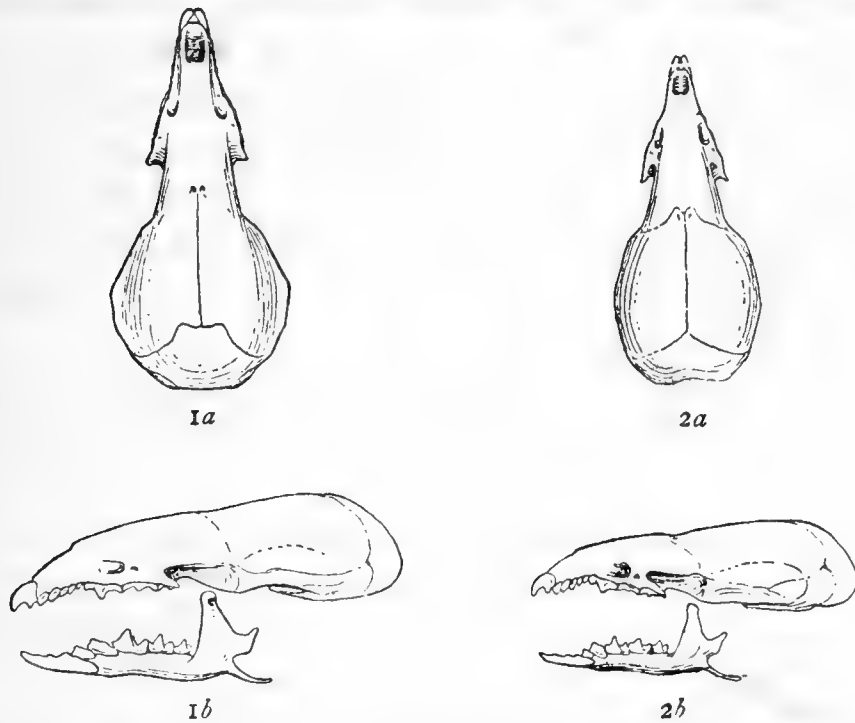


FIG. 25.—SKULLS OF (1) *Sorex araneus* and (2) *S. minutus*; (a) from above, (b) from the side.

about the trading stations and native villages, and there they forage and penetrate every corner of the houses with all the persistence of the domestic Mouse. Scores of them were killed about our houses at Saint Michael every winter, and they were equally at the other stations throughout the interior. . . .

"After snowfalls they travel from place to place by forcing a passage under the snow, and frequently keep so near the surface that a slight ridge is left to mark their passage. On the ice of the Yukon I have traced a ridge of this kind over a

¹ See *Irish Naturalist*, 1910, 125.

² *Natural History of Alaska*, 1887, 270-271.

mile, and was repeatedly surprised to see what a direct course the shrews could make for long distances under the surface."

In Ireland the position of the Pygmy Shrew is comparable to that of the Irish Stoat, in that it is the sole representative of its genus; while in England, on the contrary, there are two land-shrews and the Stoat and Weasel, two pairs of animals which differ considerably in size, and evidently subsist for the most part on prey corresponding to their respective strength.

When once known, the general appearance and colour of the Pygmy Shrew are easily recognised; but for those who have not previously met with it, the most useful characters are the long hairy tail, reaching a length equal to about two-thirds of that of the head and body, as against only about one-half in the Common Shrew, and the absence of a tricoloured pelt. The size of the hind feet is absolutely distinctive, and any shrew in which these reach or exceed a length of 12 mm. may be set down as of the larger species.

GENUS NEOMYS.

(*Sorex* of old writers, but not in Linnæus.)

- 1829. NEOMYS, Jakob Kaup, *System der Europäischen Thierwelt*, i., 117 (not *Neomys* of Bravard, 1848-1852 = *Theridomys*; not *Neomys* of Gray, 1873 = a rodent); Thomas, *Zoologist*, 1898, 100 and 102; based on *Sorex daubentonii* of Erxleben = *S. fodiens* of Schreber.
- 1829. LEUCORRHYNCHUS, Jakob Kaup, *op. cit.*, 118; based on *Sorex lineatus* of Geoffroy = *S. fodiens* of Schreber, and *S. leucodon* of Hermann in Zimmermann = *Crociodura leucodon*.
- 1829. HYDROGALE, Jakob Kaup, *op. cit.*, 123 (not *Hydrogale* of Pomel, 1848 = *Sorex fimbripes* of Bachman; not *Hydrogale* of Gray, 1865, a carnivore); based on *Sorex remifer* of Geoffroy = *S. fodiens* of Schreber.
- 1832. CROSSOPUS, J. Wagler, Oken's *Isis* (Jena), 275; based on *Sorex fodiens* of Schreber.
- 1835. HYDROSOREX (part), G. L. Duvernoy, *Mém. Soc. Mus. d'Hist. Nat.* (Strassburg), 17 and 33, pl. i., figs. 2 and 2*b*; pl. ii., figs. 4 and 5; pl. iii., figs. 1, 7, 8, 17th June and 2nd December 1834; based on *Sorex fodiens* (description) + *S. araneus* (fig. of skull) and *S. tetragonurus* = *S. araneus tetragonurus*.
- 1835. AMPHISOREX, G. L. Duvernoy, *op. cit.*, 23, pl. i., fig. 1*b*; pl. ii., fig. 6; pl. iii., figs. 3 and 9; based on *Sorex hermanni* of Duvernoy = *Neomys fodiens*.
- 1838. HYDROSOREX, G. L. Duvernoy, *L'Institut* (Paris), vi., 226, No. 112, April; and *Mém. Soc. Mus. d'Hist. Nat.* (Strassburg), Suppl., 4, pl. iii., figs. 1 and 8, 30th January 1838; based on *H. hermanni* of Duvernoy, *S. fodiens* of L. Gmelin, *S. carinatus* of Hermann, *S. daubentonii* of Erxleben, *S. remifer* of Geoffroy, and *S. lineatus* of Geoffroy, all = *S. fodiens*.



THE STOAT.



1838. PINALIA, J. E. Gray, *Proc. Zool. Soc.* (London), 1837, 126, published 14th June 1838; a MS. synonym of *Crossopus*.
 1848. GALEMYS (part), A. Pomel, *Archives Sci. Phys. et Naturelles* (Geneva), 249, November; included *Brachysorex* of Duvernoy, *Crossopus* of Wagler, and *Pachyura* of de Selys; not *Galemys* of Kaup, 1829, a genus of *Talpidae*.
 1853. MYOSICTIS, A. Pomel, *Catalogue méthodique et descriptif des Vertébrés fossiles du Bassin de la Loire*, 14; based on a fossil from a late pleistocene deposit; not hitherto distinguished generically from NEOMYS.
 1876. PINULIA, A. R. Wallace, *Geographical Distribution of Animals*, ii., 191; a misprint for *Pinalia*.

Synonymy:—The older naturalists included the water shrews in the genus *Sorex*, and, after its subdivision, *Crossopus* of Wagler was at first thought to be the earliest generic name applicable to them. Later researches have, however, shown that *Neomys* of Kaup has clear precedence.

The genus *Neomys* includes but one **British species**, the well-known *N. fodiens*, a characteristic inhabitant of streams and rivers, ranging across Europe and Asia at least to Tomsk, but absent from America and Africa. This species has the tail keeled (Plate VII., Fig. 3) and the feet fringed (Plate XI., Figs. 1, 2, and 3), but in central Spain and the Pyrenees; the Alps and Hungary; and near Erzerum, Turkey in Asia, there occur forms—*N. anomalus* of Cabrera; *N. milleri* of Mottaz; and *N. teres* of Miller, from the tails of which the keel is said to be absent.

Neomys makes its first known appearance in Britain in the late **pliocene** Forest-bed of Norfolk, where it is represented by the abundant remains of an extinct species called, by Hinton, *N. newtoni*, and characterised by its small size and the extreme form of the mandibular condyle. A second extinct form, to be fully described later by Hinton as *N. browni*, from the middle pleistocene brickearth of Grays, Essex, was also smaller than *N. fodiens*, and had a mandibular condyle of peculiar form.

The genus bears a strong resemblance to *Sorex*, and has a similar lateral gland and valves in the ear, although the latter are often described as peculiar. The hands and feet are also built on a similar plan, but carry swimming-fringes and smaller pads. The hand is relatively longer, so that the pads are more widely separated, especially the posterior pair (see plates). In both hand and foot the fourth, not the third, digit is the longest.

The generative organs, of both sexes, are usually described as opening within the same ring as the anus, but Adams informs me that this condition is by no means invariable. The vagina is apparently perforate at all ages (Adams). The penis is broad and provided with lateral processes. The muzzle is broader and blunter, especially at the tip, than in *Sorex*.

The stomach is globular and without pyloric elongation (Jenyns, *Ann. and Mag. Nat. Hist.*, June 1841, 267).

There are ten **mammæ**, arranged in five pairs along almost the whole ventral surface.

The **skull** is larger and the **teeth** are altogether more powerful than in *S. araneus*. The interpterygoid groove is

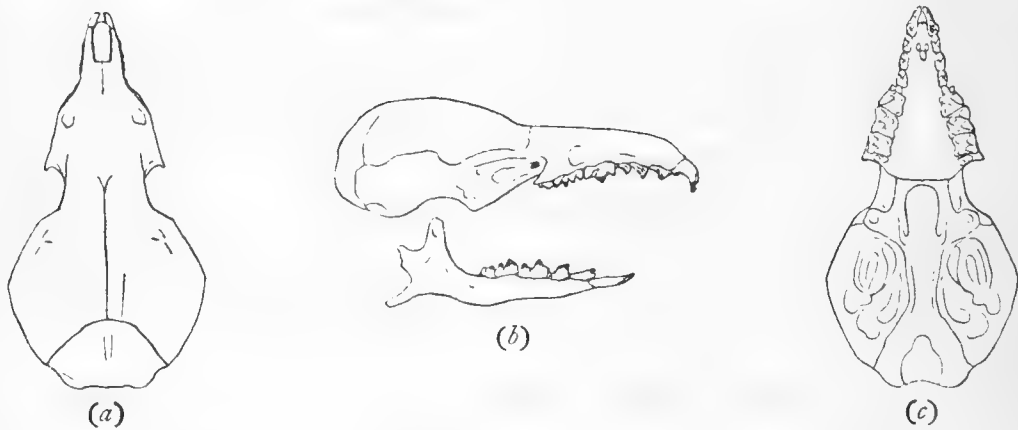


FIG. 26.—SKULL OF *Neomys fodiens*—(a) from above; (b) from the side; (c) from beneath. (Drawn by G. Dollman.)

broad and the massive naso-frontal region is evidently in correspondence with the well-developed snout. The peculiar articulation of the mandible has been described above on page 78.

The **dental formula** is—

$$i \frac{3-3}{2-2}, \quad c \frac{1-1}{0-0}, \quad pm \frac{2-2}{1-1}, \quad m \frac{3-3}{3-3} = 30,$$

there being one unicuspid less on each side of the upper jaw than in *Sorex* (Fig. 24, No. 3, p. 90). The middle upper incisors are large and prominent, but, whereas in *Sorex* the second cusp reaches a length not much, if at all, inferior to that of the first, in *Neomys* the two are quite uneven, the second, although sharp, being so short that it alters the whole appearance of the tooth, depriving it of its forked outline. These teeth are less divaricated at their point of origin than in *Sorex*; although not

always touching, they usually meet sooner, and where they approach each other a small process or fusion often joins them together. The upper unicuspid has its base more dilated than in *Sorex*; the first and second are of about equal size and more prominent than the second cusp of the central incisors (the three are about equally prominent in *Sorex*); the third is smaller than the first and second; the fourth is minute, and, being situated somewhat inwards of the line of teeth, is partially concealed by its neighbours.

In the lower jaw the middle incisors are more produced than in *Sorex*, and their upper margin shows only one serration, an obtuse prominence situated near the base and wearing away with age. Of the two following teeth the second is the larger, and is quite distinctly forked, the posterior cusp being but little inferior to the anterior. (The teeth of the Water Shrew were well described by Jenyns in *Mag. Zool. and Bot.*, 1838, 31.)

The main cusps are coloured brown as in *Sorex*, but less markedly so, and as the animal grows older the wearing down of the colouring matter is so considerable that there may eventually remain no trace of it.

The **most nearly allied genera** have been indicated under *Sorex*. The genus is not represented in America, but the shrews of the Soricine sub-genus *Neosorex* are stated to possess almost identical habits and a very similar external appearance.

Except that they are directly fitted for an aquatic life, and their blunt snouts are not so suited for searching for insects in minute crevices, the **habits** and temperament of the water shrews do not differ strikingly from those of the preceding genus. In fact, they are not by any means restricted to the neighbourhood of water, but are capable of living, although perhaps only for limited periods, in quite dry districts, and they climb with much skill. Being larger and stronger animals than the other shrews, they frequently attack small vertebrates, and more readily submit to captivity. Their dead carcasses are not encountered in anything like the numbers prevailing in the case of the land shrews, so that perhaps they live to a greater age.

THE WATER SHREW.

NEOMYS FODIENS (Schreber).*NEOMYS FODIENS BICOLOR* (Shaw).

1667. *MUS ARANEUS*, the ERDSHREW, or FIELD MOUSE, . . . alter dorso nigro ventreq; albo, Christopher Merrett, *Pinax*, 167.
1762. *MUSARAIGNE D'EAU*, L. J. M. Daubenton, *Hist. de l'Acad. Roy. des Sci.* (Paris), 211, pl. 1, f. 2, 1756; described from Burgundy, France.
1771. *SOREX FODIENS*, Thomas Pennant, *Synopsis of Quadrupeds*, 308, sp. 236, from Pallas's unpublished plates; also, *British Zoology*, ed. 4, 1, 126, 1776 (Warrington); London issue, 1776, 110; ed. of 1812, 1, 155, pl. xi.; a *nomen nudum*, being without description and not used in binomial sense, therefore inadmissible in zoology.
1776. *SOREX AQUATICUS*, P. L. S. Müller, *Natursystems Supplements und Register Band*, viii., pl. ii., described from France and based on Buffon; not *Sorex aquaticus* of Linnæus, 1758, 36 = *Scalops aquaticus*.
1777. *SOREX FODIENS*, J. C. D. von Schreber, *Die Säugthiere*, iii., 571, pl. clxi., for date see Sherborn, *Proc. Zool. Soc.* (London), 1891, 589; described from Berlin, Germany; Hermann in Zimmermann, *Specimen Zoologicæ Geographicæ*, etc., 1777, 500; also, *Geographische Geschichte des Menschen*, etc., 1780, ii., 383, sp. 314; Bingley; Fleming; Jenyns; Bell (ed. 1); MacGillivray; Clermont; Beddard.
1777. *SOREX DAUBENTONII*, J. C. R. Erxleben, *Systema Regni Animalis*, 124, naming Daubenton's *Musaraigne d'eau*.
1780. *SOREX CARINATUS*, Johannes Hermann in E. A. W. Zimmermann's *Geographische Geschichte des Menschen*, etc., i., 383, sp. 314; described from Strassburg, Germany; see Hermann, *Tabula Affinitatum Animalium*, etc., 1783, 79, sp. 5, and *Observationes Zoologicæ*, 1804, 47; Duvernoy, *Mém. Soc. Mus. d'Hist. Nat.* (Strassburg), 17, June and December 1834, published 1835 (date from Jenyns), and *L'Institut* (Paris), vi., No. 226, 112, April 1838 (a summary of his paper read before the Nat. Hist. Soc. of Strassburg, 30th January 1838).
1791. *SOREX BICOLOR*, George Shaw, Shaw and Nodder's *Naturalist's Miscellany*, ii., pl. 55, and index No. 55; described from Oxford, England (date from Sherborn, *Ann. and Mag. Nat. Hist.*, April 1895, 375-376).
1792. *SOREX BICAUDATUS*, Robert Kerr, *Animal Kingdom*, 208: renaming Hermann's *S. carinatus* from Pennant; described from Strassburg, Germany.
1793. *SOREX EREMITA*, F. A. A. Meyer, *Zool. Annalen*, i., 323; described from Thuringia, Germany.
1793. *SOREX FLUVIATILIS*, *auct. et op. cit.*, perhaps from J. M. Bechstein, MS.; described from Thuringia, Germany.
1800. *SOREX FODIENS ALBUS*, J. M. Bechstein, Thomas Pennant's *Allgemeine Uebersicht der vierfüssigen Thiere*, ii., 723; described from a white variety.
1805. *SOREX CILIATUS*, James Sowerby, *British Miscellany*, 103, coloured plate 49; described from Norfolk, England; Bingley.
1809. FRINGED-TAILED WATER SHREW, W. Bingley, *Memoirs of British Quadrupeds*, 231, and *Synopsis*, 38, sp. 22 = *S. ciliatus* of Sowerby.
1811. *SOREX LINEATUS*, Isidore Geoffroy, *Ann. du Mus. d'Hist. Nat.* (Paris), xvii. 181; described from Paris, France.
1811. *SOREX REMIFER*, Isidore Geoffroy, *op. cit.*, 182; Jenyns; Bell (ed. 1); described from Abbeville, Somme, France.

1811. SOREX HYDROPHILUS, P. S. Pallas, *Zoographia Rosso-Asiatica*, i., 130; renaming *S. fodiens* of Schreber.
1818. SOREX COLLARIS, A. G. Desmarest, *Dict. Nouv. d'Hist. Nat.*, xxii., 65, naming Geoffroy's *Musaraigne noir à collier blanc*, in *Mém. du Mus. d'Hist. Nat.* (Paris), i., 309, 1815; described from islands in the mouths of the rivers Meuse and Escaut, Belgium and Holland.
1822. SOREX MACROURUS, J. G. C. Lehmann, *Observationes Zoologicae in faunam Hamburgensis*, i., 5; described from Sachsenwald, near Friedrichsruh, Schleswig-Holstein, Germany.
1826. SOREX AMPHIBIUS, C. L. Brehm, *Ornis* (Jena), ii., 38; described from Renthendorf, Thuringia, Germany.
1826. SOREX NATANS, C. L. Brehm, *op. cit.*, 44; described from Renthendorf, Thuringia, Germany.
1826. SOREX STAGNATILIS, C. L. Brehm, *op. cit.*, 47; described from Renthendorf, Thuringia, Germany.
1829. NEOMYS DAUBENTONII, Jakob Kaup, *System der Europäischen Thierwelt*, 117.
1829. LEUCORRHYNCHUS LINEATUS, Jakob Kaup, *op. cit.*, 118.
1829. HYDROGALE REMIFER, Jakob Kaup, *op. cit.*, 123.
1830. SOREX RIVALIS, C. L. Brehm, Oken's *Isis* (Jena), 1128; described from Renthendorf, Thuringia, Germany.
1832. SOREX MUSCULUS, J. Wagler, Oken's *Isis* (Jena), 54; described from Bavaria, Germany.
1832. SOREX PSILURUS, J. Wagler, *loc. cit.*; described from Bavaria, Germany.
1832. CROSSOPUS FODIENS, J. Wagler, *op. cit.*, 275; Blasius; Fatio; Bell (ed. 2); Alston, *Fauna of Scotland*, 1880, 10; Flower and Lydekker; Lydekker; Johnston; Winge.
1832. CROSSOPUS MUSCULUS and C. PSILURUS, J. Wagler, *loc. cit.*
1832. OARED SHREW, William Yarrell, *Proc. Zool. Soc.* (London), 109, and Loudon's *Mag. of Nat. Hist.*, v., 598, 1832; naming *S. remifer* of Geoffroy; Fleming; Bell (ed. 1).
- 1832-41. CROSSOPUS CILIATUS, Charles Lucien, Prince Bonaparte, *Fauna Italica*, pl. 18, fig. 7 (coloured).
1834. SOREX NIGRIPES, H. B. Melchior, *Den danske Stats og Norges Pattedyr*, 68; new name for *S. natans* of Brehm.
1835. HYDROSOREX FODIENS, G. L. Duvernoy, *Mém. Soc. Mus. d'Hist. Nat.* (Strassburg), 1834, 17 and 33, pl. 2, fig. 4; pl. 3, figs. 1 and 8, 17th June and 2nd December.
1835. AMPHISOREX HERMANNI, G. L. Duvernoy, *loc. cit.*, 23, 34, pl. 1, fig. 1b; pl. 2, fig. 6; pl. 3, figs. 3 and 9; described from Strassburg, Germany.
1837. AMPHISOREX CILIATUS, J. E. Gray, *Proc. Zool. Soc.* (London), 125.
1837. AMPHISOREX PENNANTI, J. E. Gray, *op. cit.*; also, *Ann. and Mag. Nat. Hist.*, 1839, 287; described from England.
1838. AMPHISOREX CONSTRICTUS, G. L. Duvernoy, *L'Institut* (Paris), vi., No. 226, 112, April, from *Mém. Soc. Mus. d'Hist. Nat.* (Strassburg), Suppl. 4, 30th January 1838.
1838. HYDROSOREX HERMANNI, H. FODIENS, H. CARINATUS, H. DAUBENTONII, H. REMIFER, H. LINEATUS, *auct. et op. cit.*
1838. AMPHISOREX LINNEANA, J. E. Gray, *Ann. Nat. Hist.*, 287, December; described from North Bothnia, Sweden.

1839. SOREX FODIENS, var. LEUCOTIS, E. de Selys-Longchamps, *Études de Micro-mammalogie*, 25, 142 ; described from St Gervais, at the foot of Mt. Blanc, Haute-Savoie, France.
1839. SOREX FODIENS, var. MAJOR and SOREX FODIENS, var. ALBIVENTRIS, *auct. et op. cit.*, 142 ; named, but without description.
1840. CROSSOPUS SOWERBYI, Charles Lucien, Prince Bonaparte, *Fauna Italica*, i., 29 (under *S. fodiens*), renaming *Sorex ciliatus* of Sowerby.
- 1853.? MYOSICTIS (CROSSOPUS) FODIENS, M. Pomel, *Catalogue méthodique et descriptif des Vertébrés fossiles du Bassin de la Loire*, 14-15.
1870. SOREX INTERMEDIUS (part), E. Cornalia, *Catalogo descrittivo dei Mammiferi osservati fino ad ora in Italia*, 27 (not seen) ; although quoted under *Sorex alpinus* by authors, is based upon a made-up specimen of *Sorex* and *Neomys* ; see Sordelli, *Atti della Soc. Ital. di Sci. Nat.*, xxxviii., 362-365, 17th December 1899.
1898. NEOMYS FODIENS, Oldfield Thomas, *Zoologist*, 100 and 102 ; Miller ; Collett.
1901. NEOMYS FODIENS MINOR, G. S. Miller, junior, *Proc. Biol. Soc.* (Washington), xiv., 45, 25th April 1901 ; described from Montréjeau, Haute-Garonne, France.
1905. CROSSOPUS ou SOREX IGNOTUS, Victor Fatio, *Archives des Sci. phys. et naturelles*, 15th February, 202 ; described from Switzerland, from *Neomys fodiens* (skull) + *Sorex araneus nudus* (jaw) ; see Mottaz, *Bull. Soc. Zool.* (Geneva), i., 9, 15th November 1908, 167.
1905. NEOMYS FODIENS NAIAS, G. E. H. Barrett-Hamilton, *Ann. and Mag. Nat. Hist.*, May, 507 ; described from Hatzeg, Hunyad, Hungary.
1905. NEOMYS FODIENS CILIATUS, G. E. H. Barrett-Hamilton, *Ann. and Mag. Nat. Hist.*, 508, May ; Trouessart (1910).
1906. NEOMYS FODIENS NANUS, R. Lydekker, *Zoological Record*, 1905, 34, August 1906 ; misprint for *N. f. naias*.

The plan of the **synonymy** is the same as that of the two other shrews.

The Water Shrew owes its legion of synonyms to its puzzling variations, together with the general obscurity with which, until recent years, it has been surrounded.

The specific name *fodiens* is usually cited as of Pallas, or Pallas in Schreber, but although Pallas caused drawings of it to be made which were inspected and utilised by Pennant amongst others, they were not published in time to give the true author of the name the priority which the rules of nomenclature require. Pennant appears to have been the earliest copyist, but, since he published no description and did not follow the rules of binomial nomenclature, his *fodiens* is a mere *nomen nudum*. Schreber's *fodiens*, although there is no reason to oust it, dates from the same year as Hermann's *fodiens* and Erxleben's *daubentonii*. The latter was applied in honour of the French naturalist of that name, who independently met with and described the Water Shrew in the same year as Pallas.

The swollen synonymy dates from Hermann of Strassburg. Working with Gall's specimens, he described several forms of shrew, of which

tetragonurus has been dealt with under *araneus*; *russula* and *leucodon* are each a *Crocidura*, while *carinatus* is evidently a water shrew; *constrictus* is a doubtful form, described from young in the nest and perhaps a *Crocidura*. Like Pallas, Hermann was slow to publish, and his manuscripts were copied by Zimmermann, Schreber, and others, who are sometimes cited, although wrongly, for Hermann's names, while Hermann's own work was held back until after his death.

Many years later, Duvernoy, in setting himself to explain Hermann's species, added another synonym in his own *hermanni*, and introduced confusion by including *fodiens* and *tetragonurus* in a single new genus, *Hydrosorex*. His description of *fodiens* correctly indicated a water shrew, but the skull which he figured in correspondence with it was that of a true *Sorex*, a fact which induced Jenyns to doubt the identity of British *fodiens* with that of Duvernoy, and to suggest the use of Shaw's *bicolor* (1791) for the former (*Mag. Zool. and Bot.*, 1838, 37). The truth did not, however, escape Nathusius, who, in Wiegmann's *Archiv für Naturgeschichte*, 1838, i., 19-47, reviewed the knowledge of shrews at that date, as did also de Selys-Longchamps in the year following.

Meanwhile, in 1805, Sowerby had bestowed the name of *ciliatus* upon a melanic English specimen, and Geoffroy's *remifer* (1811) was based upon a similar one from France, his *lineatus* of the same date being probably the black and white form of the same locality.

This differentiation of the Water Shrew into two forms, the one dusky, the other with white underside, met with wide acceptance amongst European naturalists; but those of Britain, except Bingley, ignored their countryman Shaw's *bicolor*, and adopted in preference Geoffroy's *remifer*, hence the presence of that term and the expression "Oared Shrew"¹ in the works of many British writers of the nineteenth century.

Gray's *pennantii* was in 1837 applied to specimens from England and France, but in 1839 he restricted it to "our English species"; his *linneana*, from North Bothnia, Sweden, and Lehmann's *macrourus*, may represent sub-species.

Shaw's *bicolor* (1791) is, without doubt, the proper technical name of the British Water Shrew, being the earliest to appear in the work of a British writer (see under Geographical Variation).

Local names:—Like the Pygmy, the present species is probably not always distinguished from the Common Shrew. The following names are said to have direct application to it:—*Blind-mouse* of the fen-men (Pennant); *famh-uisge* = "water mole" (Alston), and *lavellan* of Scotland; *otter shrew* of Cheshire (Coward and Oldham); *water mole*; *water-rannie*; *white-breasted shrew*.

¹ "The Oared Shrew (*Crossopus ciliatus*)" appeared again, as well as the Water Shrew, in British mammals as arranged by George Abbey, *The Balance of Nature*, 1909, 5.

Distribution :—This Water Shrew ranges through arctic, boreal, and transitional Europe and Asia, from sea-level to at least 6000 feet (Blasius). It reaches the extreme north of Scotland (Bruce), and in Skandinavia (whence I have seen specimens taken at 2200 feet by Ticehurst), it is more or less numerous as far north as Finmarken ($70^{\circ} 45'$ N. lat.), and ascends the mountains to the tree line (Collett). Thence its northern limit extends through north Russia and Siberia, southwards to central Spain, Italy to Tuscany (where it is rare, but I have seen a specimen from near Vallombrosa), Austria-Hungary (at least to Hatzeg, south Carpathians), the Balkan States, northern Caucasus and the districts of the lower Volga; and from Great Britain eastwards at least to Tomsk, the western Altai and the Jenesei. It is not found in the Himalayas, records from that region being based upon confusion with Gray's *Crossopus himalayaicus*, a *Chimarrogale*.

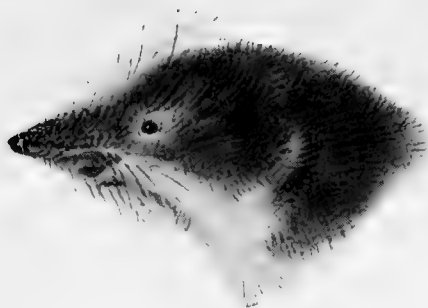
It is not represented in America (see under genus *Neomys*).

It is locally distributed all over **Great Britain**, westwards to the Pembroke coast (Howell, *Field*, 29th April 1905, 726), and Anglesey (Coward), northwards to Sutherland and Caithness (Bruce), eastwards and southwards to the sea, but doubtfully to the Isle of Wight (Bury, *Zoologist*, 1844, 780; Wadham). It is almost restricted to the mainland, being absent from Ireland, Man, the Outer Hebrides, Orkneys (Baikie and Heddle's record in *Hist. Nat. Orcadensis*, 14, being evidently an error) and Shetlands; but is not rare in Arran (Alston), and has been recorded from Kerrera (Borrer, *Ann. Scott. Nat. Hist.*, 1893, 111). I have seen an Argyle specimen from an altitude of 500 feet; Witchell and Strugnell took one in a pond at 700 feet; and on the Stafford and Cheshire border it is found at over 1000 feet (Coward and Oldham).

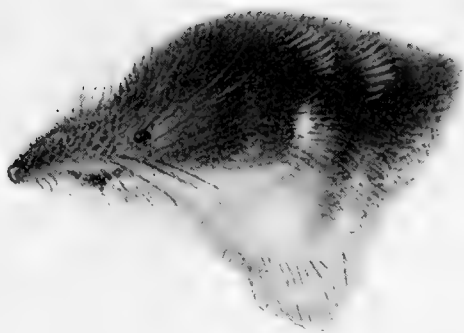
Distribution in time :—All the earlier records of *Neomys fodiens* in a fossil state in Britain (*Sorex fodiens* and *S. remifer*, Owen, *British Fossil Mammals*, 1846, 28, Fig. 14, No. 1; *Crossopus remifer*, Lydekker, *Catalogue of Fossil Mammalia*, 1885, i., 17) were based upon specimens referable to species of *Sorex*. Hinton has recently examined the fossil shrews of Britain, and finds that *N. fodiens*, or a very nearly allied form, occurs in the latest pleistocene deposits, such as those of Ightham fissures, Kent, and Dog Holes, Lancashire.

Description :—The form, general characteristics, **skull** and **teeth** of the Water Shrew are those of its genus. The under side of the tail is provided with a "keel" or double fringe of strong hairs, which extends in regular arrangement along the centre of the flat under-surface, but varies very much in development individually. The whiskers are long and numerous, reaching a length of at least 16 mm.

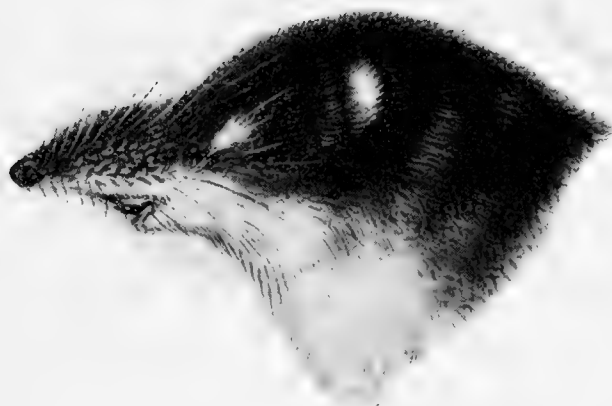
In the hands and feet the toes are beautifully ciliated with fringes of stiff hairs (see Plate XI.). The first and fifth digits are longer than in *Sorex araneus*, and resemble rather those of *S. minutus*. In the hand



(1)



(2)



(3)

HEADS (viewed from side) OF (1) LESSER SHREW ; (2) COMMON SHREW ; and
(3) WATER SHREW (magnified $1\frac{1}{2}$ times).

the tip of the first digit reaches about to the base of the second, the fifth well beyond the base of the fourth. In the foot the tips of the first and fifth digits reach about half-way to the tips of the second and fourth respectively.

The **fur** is even more beautiful and abundant than that of the Common Shrew; it varies in length from about 4 mm. in summer to 7 in winter, and in the young possesses an iridescence lost in the adult (English). The colour of the hidden basal portions of the hairs is "blackish slate" above, paler and approaching "plumbeous" below.

The animal is in its typical form very distinctly bicoloured, the **colour** of the upper side at all seasons varying from "blackish slate," or "slate black," to deep brown of quite irregular intensity; that of the under side running from dirty white or cream to some shade of "olive-gray" or "smoke gray." The two areas are sharply divided by a distinct line of demarcation, which runs on each side from a point just behind the nostrils to the shoulder, and thence along the flanks to the wrists, ankles, and base of the tail. The tail is "hair brown" above; below, including the component hairs of the keel, whitish. The foot is also hair brown, the skin of the upper surface finely mottled in dusky and lighter colours, and the fringing hairs most typically, but not invariably, whitish. There is frequently a tuft of whitish hairs arising from a valve above the antitragus, or from the edge of the conch (Plate VI., Fig. 3). Writing in the *Zoologist* for 1893, 302-303, Stott described the eye of a fresh specimen as "blue, and small."

The **moult**s appear to be effected in a similar way to those of *Sorex*, and Adams has sent me several specimens clearly undergoing a change of their coat in September, so that there is certainly an autumn moult. The keel and swimming-fringes are changed with the rest of the hairs in summer or autumn, at which time, accordingly, errors in identification are liable to occur. The moults are probably not so irregular as in the short-lived members of the genus *Sorex*, in which Adams believes that no individual survives to effect a second autumnal moult, nor changes its pelt more than twice during its life, so that the dependence of these two changes upon the age of the individual would account for much irregularity. The *young Neomys* is at first without a keel, which makes its first appearance at the base of the tail.

Individual variation is frequent, tending largely to melanism, in the extreme case of which there is no line of demarcation and the whole under side may be dusky or "hair brown." Many specimens are strongly washed with yellowish or ferruginous tints beneath; in others there is a dusky band across the throat or a thick line of the same colour in the mid-ventral region. There may be indications of a brown flank-band between the blackish and whitish hues of upper and under sides (Cocks). Adams finds that in melanic specimens the keel and foot fringe are more prominent than in the bicoloured type.

DIMENSIONS IN MILLIMETRES:—

	Head and body.	Tail without terminal hairs.	Hind foot without claws.	Ears, greatest length.	Weight in grammes.
SPECIMENS IN BRITISH MUSEUM OF NATURAL HISTORY.					
Number of items of both sexes . . .	11	11	11	5	..
Maximum	90	60	18	9	..
Average	85	53	17	8.5	..
Minimum	75	48	16.5	8	..
SPECIMENS MEASURED BY L. E. ADAMS.					
MALES.					
Reigate, Surrey :—					
1. 27th June 1911	85	51	17	..	..
2. 19th August 1911	86	53	18	8	14
FEMALES.					
Reigate, Surrey :—					
1. 5th February 1908	78	52	18.5	..	9 nearly
2. 1st September 1909	75	58	17	..	..
3. 1st September 1909	83	52	16	..	..
4. 1st October 1909	90	63	17	..	..
5. 7th December 1909	83	54	16.5	..	..
6. 3rd November 1910	82	59	18	..	..
7. 18th June 1911 (contained 7 embryos)	85	55	18	7	11
8. 2nd July 1911	80	53	16	8	13
9. 17th August 1911	78	55	18	8	11
Approximate average of 9 females . . .	81.5	55.5	17.2	7.6	11
Bishop's Stortford, Herts :—					
1. 22nd September 1911	85	55	17	8	..
2. 26th September 1911	84	53	17	8	13
3. 29th September 1911	84	53	18	8.5	13
4. 4th October 1911	78	61	18	8	12
Approximate average of 15 of both sexes	82.5	55	17.3	8 (nearly)	12
IMMATURE SPECIMENS MEASURED BY L. E. ADAMS.					
Reigate, Surrey :—					
1. Female, 14th October 1909	73	55	16	..	..
2. 20th August 1911	80	55	18	8	10.5
3. 24th August 1911	80	53	17	8	10.5
4. Female, 20th September 1911	75	55	18	10	..
5. Hambleden, Buckinghamshire, caught on a road far from water; keel beginning to show at base of tail (forwarded by A. H. Cocks, 19th August 1911)	60	40	15	5	..

Exceptional variation is somewhat difficult to recognise in an animal so naturally variable. Albinism is certainly rare, but a specimen thus affected is stated to have been included in the collection of Eyton (see *Mag. Zool. and Bot.*, 1838, 540), and Bechstein's variety *albus* was based upon a snow-white example. Witchell and Strugnell mention "a

pregnant albino female," which had been killed in the Thames and Severn Canal, near Brimscombe, Gloucestershire.

Geographical variation is in the Water Shrew much obscured by the prevalence of melanism. There is as yet no evidence that this melanism has in Britain any recognisable distribution according to locality, and I have not attempted to trace it here, though the subject is worthy of the attention of local naturalists. On the other hand, I have been able to show (*Ann. and Mag. Nat. Hist.*, 1905, 508) that British specimens are on the average duskier than those of the neighbouring continental regions, so that the British form deserves sub-specific recognition under Shaw's name, *bicolor*. At the other end of the scale is the beautiful southern Carpathian form which I named *naias*, but which later revisers have united with the true *fodiens*; in this the contrast between upper and under sides is stronger than in any other known form, yet melanic specimens nevertheless occur, as they probably do everywhere throughout the range of the species. No other sub-species are known.

Proportionate lengths:—Tail (without end hairs) about .62, hind foot about .2, and ear about .1, of head and body.

Skull:—Greatest length, 20 to 22; basal length in middle line, 18; palatal length in middle line, 10; length of upper tooth series, 9 to 11; ditto lower, 8 to 10; greatest breadth, 10 to 11; breadth at constriction, 4.5 to 5.

The **weight**, as given in the above tables, seems to be somewhat small, considering the size of the animal. Kinnear, however, sends me the figures (in grammes) for two females as 10.32 and 10.39, but another weighed by Laidlaw reached 16.4 (Eagle Clarke).

Distinguishing characters:—As compared with the Common and Pygmy Shrews, the Water Shrew is a bigger animal, with a blunter muzzle, a large tail reaching about .6 of the head-and-body length, the feet and tail beautifully "feathered" for swimming, and the colours, except where melanism occurs, strongly contrasted dusky and cream. The cranial and dental characters are absolutely distinctive.

The habits of this beautiful little creature are clearly indicated by the peculiarities of its structure. It possesses somewhat the same conformation as the two species already described, combining a thick silky coat and gracile body with a much thicker snout. The addition of stiff cilia to the sides of the toes, together with the fringe of hairs on the under surface of the tail, show that in its ordinary pursuits it requires the use of oars and rudder, and that, while, like the other British species of the family, its food usually consists of small invertebrates, it is

in the water that this food is for the most part obtained. The observations of a number of intelligent naturalists have afforded many curious details as to its mode of life, and we now know that it is not less interesting in its habits than elegant and pleasing in its form and movements.

The Water Shrew was evidently known to Merrett, but appears to have been unnoticed by naturalists for about a century afterwards, being absent from the earlier editions of Pennant. It was eventually rediscovered almost simultaneously by Daubenton, who wrote a description of it in 1756, in France, and by Pallas at Berlin.¹ The latter naturalist supplied Pennant with some unpublished prints of it in 1765, and Pennant himself met with it at Revesby Abbey, the Lincolnshire seat of Sir John Banks, in 1768.² Thereafter it became familiar to several of our early naturalists, including Patrick Neill, its first observer for Scotland, in 1808,³ George Montagu for Devonshire,⁴ Fleming,⁵ and Sowerby. These writers knew it well enough to fully appreciate its vagaries of colour. Montagu, for instance, described a specimen with the throat and breast ferruginous, while Fleming commented on the dark markings of the under side and upon the occurrence of an individual having a deep chestnut throat-band. Sowerby went a step farther and figured under the name of *S. ciliatus* a melanic specimen from Norfolk, which Jenyns with his usual perspicacity perceived to be specifically identical with ordinary *S. fodiens* of the same district. Nevertheless he admitted to the British list another

¹ In his *Zoographia Rosso-Asiatica* (1811, i., 130), Pallas states that he first observed it "jam puer Ao. 1756 circa patriam urbem Berolinum."

² So far as I am aware, Pennant nowhere explicitly states that he personally rediscovered the Water Shrew. But he was at Revesby Abbey in 1768, where, according to his own *Literary Life* (1793), he made many discoveries, and he states in his *Synopsis of Quadrupeds*, 308 (Chester, 1771), that the species was lost in England until "May 1768, when it was discovered in the fens near Revesby Abbey, Lincolnshire." The evidence, although circumstantial only, is, therefore, conclusive, even without Gilbert White's statement in his xxvith letter, dated 8th December 1769:—"De Buffon, I know, has described the water shrew-mouse: but still I am pleased to find you have discovered it in Lincolnshire, . . ."

³ In the 1808 edition of Allan Ramsay's *Gentle Shepherd*, i., 269, as pointed out by W. Evans correcting E. R. Alston.

⁴ *Linnean Transactions*, vii., 276, 1804.

⁵ *Wernerian Society's Memoirs*, ii., 238, 1812.

supposed species, the Oared Shrew, *S. remifer* of Isidore Geoffroy, with the result that in the works of many British writers, such as Bingley, Bell (first edition), MacGillivray, and others, England was for long reputed to possess two species of Water Shrew, the Common or *S. fodiens* and the Oared, being either Sowerby's or Geoffroy's species. Other writers, such as Donovan and Fleming, never divided the species, and the matter remained for long unsettled. The Oared Shrew was finally removed from the British list by R. F. Toms, who in Bell's second edition showed that both the names *ciliatus* and *remifer* were applied to dark forms of *S. fodiens*. And here the matter rested until I pointed out that British specimens are on the average duskier than those from the Continent, and therefore represent a sub-species to which Sowerby's name is applicable.

There is, perhaps, no British mammal whose manners so easily lend themselves to observation as the Water Shrew. Either because it pursues its business with a complete intentness and abstraction from other affairs, or because, as is more likely, since its eyes are very inconspicuous and lie almost buried in its fur, the sphere of its vision is very limited, it may be approached somewhat easily and by a quiet observer is not easily put to flight. Its ordinary occupations and appearance have therefore been frequently described. It was fairly well figured by Bingley and by Donovan, particularly by the former; and its mode of life was not inaccurately epitomised in their respective works, but J. F. M. Dovaston¹ is usually credited with having written the first detailed description of its habits. During the spring of 1825, Dovaston observed it repeatedly. Its manner was to glide "from the bank, under water, and bury itself in the mass of leaves at the bottom. . . . It very shortly returned, and entered the bank, occasionally putting its long sharp nose out of the water, and paddling close to the edge. This it repeated at very frequent intervals, from place to place, seldom going more than two yards from the side, and always returning in about half a minute. . . . Sometimes it would run a little on the surface, and sometimes timidly and hastily come ashore, but with the greatest caution, and instantly

¹ Loudon's *Mag. Nat. Hist.*, ii., 219, 1829.

plunge in again. . . . When under water he looks grey, on account of the pearly cluster of minute air-bubbles that adhere to his fur, and bespangle him all over."

Although Dovaston's essay undoubtedly deserves the commendation with which it has been received, J. S. Knapp's treatment of the same subject, published at about the same date as Dovaston's, is also worthy of praise.¹ Since that date, many naturalists have repeated or amplified the story, and the work of MacGillivray, J. G. Wood, Mr W. Hodgson,² and Mr W. Evans³ are particularly to be commended. The two latter naturalists have especially noticed the buoyancy of water shrews, and their playfulness both in the water and on land. "When the sun shone out brightly," wrote Mr Hodgson, "their glossy submerged coats glistened like frosted silver. . . . Their watery gambols strikingly reminded the spectator of those of a brood of ducklings at play." Quite recently Mr J. G. Millais has waxed eloquent over this wonderful activity, and has figured one in the act of leaping clear of the water in a surprising, fish-like manner. He regards "the habit of making big bounds" as especially characteristic of the animal, which, indeed, not unfrequently indulges in them when surprised ashore, setting off "towards the river or pond with immense leaps through the grass, which if the animal were of the size of the spring-buck would be among the marvels of animal progression."

The Water Shrew is not by any means a rare animal, but it would appear to be of local distribution. Since the introduction of improved methods of trapping small mammals it often falls a victim, taking freely almost any bait if placed in localities where it occurs. Sometimes it may be caught in an unbaited cyclone trap placed on the bottom of a stream on the chance of its trying to pass through it.

It swims principally by the alternate action of both pairs of feet or by flexions of the whole body, which produce an unequal or wriggling motion. The head is slightly raised above the surface, says Mr Douglas English,⁴ and three-quarters of the

¹ *Journal of a Naturalist*, ed. 2, 143, etc., 1829.

² *Trans. Cumberland and Westmorland Assoc.*, xi., 38-39, 1886.

³ See also V. Walmsley, *Zoologist*, 1844, 428-429; and C. E. Stott, *Journ. cit.*, 1893, 302.

⁴ *Some Smaller British Mammals*, undated, 73.

body are out of the water. The most remarkable feature of its appearance when *in* the water, and on this point all observers are agreed, is a curious flattening of the body, the sides being expanded and the tail, of course, extended backwards. It swims with great velocity, and is equally at home beneath or on the surface, but, according to Mr English, dislikes long immersions, which sodden the hair on its head and back. Like the dipper amongst birds it possesses the power of walking, or even of rapidly running upon the bottom of a stream,¹ and its activity is so surprising as to give the impression that it can walk on the surface also. Again, like some species of sea-birds, it simply runs in and out of water, as Mr E. T. Daubeny has remarked,² as if air and water were both alike to it, and it were equally at home in either element, but it can dive well enough if disturbed, dropping in with a little splash.³ It is at all times a very beautiful and pleasing object. When submerged, innumerable bubbles, resting on its deep brown coat, silver it to a blue-grey tint; then as it leaves the water its fur is seen to be perfectly dry, having repelled the liquid as completely as the feathers of a water-fowl.

Although it obtains most of its food in streams or ponds, the Water Shrew is in no way dependent for its existence upon water. In fact, it has been so often found at such distances from situations apparently most congenial, as to suggest that it is at least equally at home in woods and pastures. It is its habit to haunt the ponds or streams which it affects in pairs or little colonies, and it is possible that on the exhaustion of the food-supply in these, it resorts to dry land, there to wander until it finds some new aquatic locality untenanted. In some cases its presence in a dry locality is probably due to its following up some old, and now hardly perceptible, water-course. This is the case in the dry farm occupied by Mr A. H. Cocks, where there is a water-course which flows during a very few weeks at irregular intervals of a few years down the valley to the Thames.⁴ The water shrews discover the first moistening of the bed, before it is noticeable

¹ See H. Laver's *Essex*; also W. Prior, *Naturalist*, 1899, 240.

² *Nature Notes*, 1902, 227. ³ T. A. Coward, MS. ⁴ A distance of four miles.

to human eyes, and follow it up, gradually dispersing to right and left into the perfectly dry fields.

The Water Shrew has been observed hunting amongst dead leaves in plantations,¹ and grubbing in the droppings of horses on a public road,² as well as in hay- or corn-fields.³ It has been turned out from a snug retreat amongst the roots of an old hedge,⁴ has been found dead on top of a ridge of dry hills, and has been taken in the pantry of a house, in a greenhouse,⁵ and in a box full of straw in a dry cellar.⁶ In one instance reported by Mr C. H. B. Grant, one was trapped on ground "like a rock" at a distance of about three miles from any water in the intensely dry heat of August 1899.⁷ It may even breed at a distance from water, since Mr F. Coburn⁸ received a nursing female, which had been caught by haymakers near Birmingham on 27th June, in a meadow far from any river or stream.

Like the other shrews, this species is a kind of omnivorous carnivore, devouring, apparently without fear or favour, all living things of a size and strength inferior to itself. Mr Millais once observed one burrowing like a mole for worms by a streamside, but there can be no doubt that its more ordinary food is found amongst the smaller inhabitants—the crustaceans, molluscs and insects—of the brook or pond. These it hunts with great assiduity, turning over pebbles and poking its nose under larger stones or amongst dead leaves and mud for its prey, which when caught are usually conveyed to the bank or even to the burrow to be devoured. The feeding-place may be indicated by a heap of rejectamenta, as found by Mr W. Jeffery, junior,⁹ who observed one making a meal of caddis-

¹ W. Webster, junior, *Zoologist*, 1848, 2009; and H. B. Tristram, *Journ. cit.*, 1853, 3905.

² Sir O. Mosley, *Zoologist*, 1850, 2697.

³ G. Wolley, *Journ. cit.*, 1848, 2289.

⁴ J. J. Briggs, *Zoologist*, 1848, 2280-2281.

⁵ Forrest, MS.; see also James Hardy, *Proc. Berwickshire Nat. Club*, viii., 527, 1879.

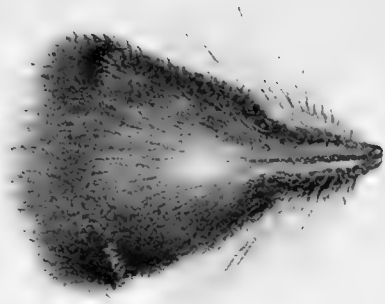
⁶ Eliza Brightwen, *Wild Nature won by Kindness*, ed. 7, 121, etc., 1896.

⁷ *Zoologist*, 1900, 141; see also O. Grabham, *Journ. cit.*, 1900, 186; Jenyns, MacGillivray, Evans, Service, etc.

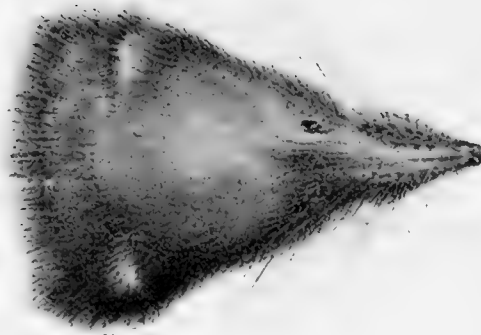
⁸ *Journ. cit.*, 1891, 185. Cocks's captive mentioned below on p. 145, produced young immediately after having been caught in a very dry field of clover.

⁹ *Zoologist*, 1874, 3829; also *Journ. cit.*, 1868, 1254.

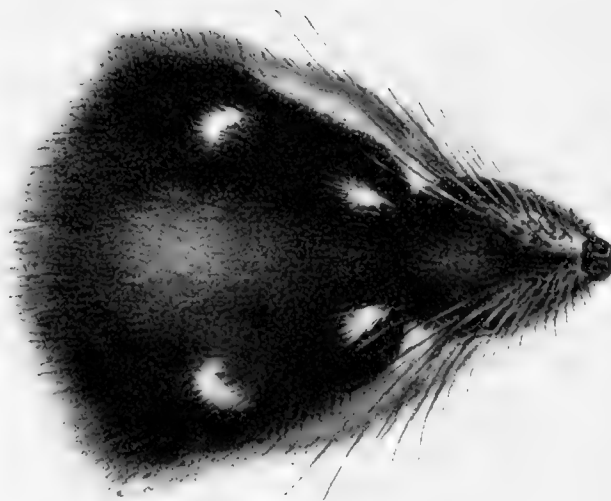




(1)



(2)



(3)

HEADS (viewed from above) OF (1) LESSER SHREW; (2) COMMON SHREW; and
(3) WATER SHREW (magnified $1\frac{1}{2}$ times).

worms, the empty cases of which were deposited at a single place on the bank: and Mr Coward has also sent me an instance of the same kind of deposit on an old moorhen's nest.

There is ample evidence to show that the Water Shrew will eat, or at least attack, both frogs and fish, together with their spawn¹ and fry. Frogs even of large size are seized by the nose or leg² and dragged off, with much shaking and outcry, to the burrow. Attacks on fish have been but rarely witnessed, but the complaints of fish-farmers are very detailed³ and are not contrary to the observations of Mr English and of the principal foreign zoologists such as Professor Robert Collett for Norway, who write of the piscivorous habits of the Water Shrew as proved beyond doubt. Of British instances may be cited Mr T. J. Bold's statement that he shot a water shrew and a fish, which he discovered "apparently rolling over and over in the water, and doing battle with all their energy."⁴ A correspondent of the late John Cordeaux's⁵ was also so fortunate as to witness the struggles of a water shrew and a small fish, which it seized "with all the pluck and ferocity of an otter poaching in a salmon-stream." Again, Mr E. G. B. Meade-Waldo informed Mr Millais that he has frequently seen these shrews chasing trout "up to a fair size," and there is among other evidence, that of Messrs J. A. Harvie-Brown and T. E. Buckley.⁶ Monsieur H. Gadeau de Kerville has, however, pushed the accusation further home, quoting Brehm as having observed one perched on the head of a carp, where it hung on by its claws, and declaring that it evinces a particular desire for the brain of fish, in order to satisfy which it does not hesitate to attack large carp, clawing at their heads, tearing out and eating their eyes, piercing the cranium and devouring its contents.

¹ A. Trevor-Battye in Lydekker; see also, *Field*, 3rd July 1909, 44; and Hy. S. (the late Henry Scherren), *Field*, 10th July 1909, 94, where much evidence, both for England and the Continent, is collected.

² C. R. Bree, *Zoologist*, 1853, 4047; W. Jeffery, junior, *Journ. cit.*, 1868, 1254.

³ A. Severn, Bibury Fishery, near Fairford, Gloucester, *Field*, 18th November, 1905, 907; Donald Walker, Welham Park Fish Hatchery, Malton, Yorkshire, *Journ. cit.*, 25th November 1905, 943.

⁴ *Trans. Tyneside Nat. Field Club*, v., 155, 1862.

⁵ *Zoologist*, 1881, 207-208.

⁶ *Vertebrate Fauna of Sutherland, Caithness, and West Cromarty*, 1887, 72-73.

The wide range of the Water Shrew's appetite is nowhere so well shown as when traps are set for it, for, although the most successful bait is probably raw meat in one form or another, and especially pieces of liver, it will eat any ordinary mouse-attracting substance such as cheese.¹ In addition, it does not despise carrion nor the bodies of other small mammals. Several instances of this kind are related in Bell's second edition. In one case a shrew was discovered in the interior of the carcase—half-dried and decomposed—of a barn-door fowl. Another shrew was found perched on the body of a full-grown trapped rat,² the tough skin of which it was attempting to pierce. Despite its projecting snout and comparatively weak teeth, it had succeeded in making a small hole through the rodent's skin; and it was most energetically employed on the enlargement of this by means both of teeth and claws. So ferocious were its actions that it might very properly be described as fighting the rat, and so intent was it upon its work that it allowed itself to be captured without resistance. Continental naturalists³ complete the dietary by the addition of young birds and animals, and there is not the slightest doubt that these may be occasionally attacked by it.

Like the Common Shrew, the present species is, at least in summer, the reverse of silent, and its cry, a shrill, chattering shriek, sometimes challenges attention. Dovaston was, however, perhaps a little too picturesque when he expressed it as a "very short, shrill, feeble sibilation, not unlike that of the grasshopper-lark, . . . but nothing near so loud or long-continued." It is probably best described by the epithet "cricket-like," and is difficult to distinguish from the voice of other shrews. In winter, according to Mr Robert Drane,⁴ the cry is rarely heard.

The residence of this animal is usually a burrow, sometimes an elaborate system of galleries with one or more of the entrances opening under water. It thus possesses a retreat whether pursued from the land or from the water, but to what extent it digs it for itself is uncertain.⁵ Probably, like

¹ Evans; Forrest, etc.

² See also R. F. Toms, *Worcestershire*, 175.

³ *E.g.*, Blasius; and de Kerville.

⁴ MS. per T. W. Proger.

⁵ Collett states that it *does* dig.

other mammals not specialised for digging, it utilises ready-made burrows as much as it possibly can. But this does not mean that it cannot also dig for itself, and one which Mr Cocks kept in captivity for some months finally escaped by grubbing away the somewhat decayed edges of two boards in a very vigorous manner. Monsieur de Kerville describes the burrow as being provided with three entrances, one submerged, a second at the surface of the water, and the third, sometimes multiple, opening to the land and away from the stream; but such a plan is certainly not invariable, for I have caught a Water Shrew by damming up a small stream and flooding it out of its abode. Occasionally, according to Blasius, it is said to make use of the galleries of the Mole.

In the deep recesses of the burrow may be found, according to Mr Millais, "a compact ball of grass with a few oak leaves, very similar to the nest of the Common Shrew, only larger."¹ Two such were found contiguously by Mr C. E. Wright² under a wild duck's nest in an old pollard willow. They were composed of shreds of wood, small willow roots, and a few pieces of fine grass.

Like the other shrews, this species is by no means entirely nocturnal, and it is frequently to be observed abroad by day. That it also moves about by night is shown by the occurrence of its skull in the "pellets" of owls, and these birds have been seen hunting it.

It is also as active in winter as in summer, and Mr G. H. Caton Haigh has often seen it swimming under the ice beneath his feet while skating, thus confirming similar statements by Blasius for Germany and Pallas for Siberia. A charming account of its movements in a half-frozen burn may be read in the *Lays of the Deer Forest*, by John Sobieski and C. E. Stuart.³ Occasionally, however, as Jonathan Couch noticed in 1855,⁴ the shrews are driven from their ordinary haunts by the ice; but the plump condition of those which he found showed that they had not owed their death to starvation. It is probable, according to Mr Millais, that heavy floods are more

¹ A little chamber lined with moss (Collett).

² Per L. E. Adams, MS.

³ Vol. ii., 311-313.

⁴ *Zoologist*, 1855, 4702.

disturbing to them than any atmospheric changes such as frost or drought.

Although there is as yet no evidence that, as suggested by Mr Adams's observations on the Common and Pygmy Shrews, this species is also an "annual," it is subject to the usual mortality of its family, as noticed by Knapp,¹ by Couch,² and, over one hundred years ago, by Shaw. But the number of deaths seems to be much less than in the two other species; and Mr Drane³ remarks that in Norfolk he daily found dead ones on roads and paths in winter, but only in that season. It is so irascible and pugnacious that it sometimes falls a victim to its love of fighting. In Scotland one of Buckley's⁴ correspondents found two in a new cistern, from which they were unable to escape; one was sitting upon a stone busily engaged in devouring the remains of its companion in misfortune. Mr Harvie-Brown sends me a somewhat similar tale of cannibalism, and Cordeaux⁵ once found a pair of fully grown males in June sitting face to face, dead, but posed in a life-like attitude. Both were in good condition and exhibited no trace whatever of ill-usage, except slight stains of blood on their chests. In the island of Kerrera, William Borrer⁶ also met with the bodies of two males in equally good condition. They too had probably fallen in mortal combat, although they were separated by a distance of a few yards.

When intent upon its food,⁷ or perhaps, only if unwell, this shrew may sometimes be approached and taken alive, as already described above, in the case of one found grubbing amongst dung upon a road by Sir O. Mosley.⁸ It is not, however, at all tractable, and, when seized, bites savagely, its sharp teeth being powerful enough to pierce a thick glove.⁹ Mr Rope has noticed¹⁰ one of its most astonishing accomplishments, namely, its skill in climbing; one which he kept in a cage for a few hours not only ascended easily the upright wires of its prison, but even made its way along the top, clinging

¹ *Op. cit. supra.*

² *Zoologist*, 1855, 4702.

³ Per T. W. Proger, MS.

⁴ *Ann. Scott. Nat. Hist.*, 1892, 157.

⁵ *Zoologist*, 1866, 327; see also Grabham, *Journ. cit.*, 1900, 186.

⁶ *Ann. Scott. Nat. Hist.*, 1893, III-III-2.

⁷ According to Collett it sees well at a distance.

⁸ *Zoologist*, 1850, 2697.

⁹ J. J. Briggs, *Zoologist*, 1848, 2280-2281.

¹⁰ *Journ. cit.*, 1900, 477.

back downwards to the wires, an unexpected exhibition of agility in such a usually aquatic animal. This power of climbing had been previously observed by an anonymous, but evidently, as regards this point, accurate writer, who stated¹ that he had kept a pair, male and female, in captivity with some success, feeding them on raw meat and small fish, which latter they held with their forepaws, like an otter. Mr English, whose remarks have been quoted above, and Mr Cocks have kept various individual water shrews in captivity for long periods. They appeared to have some notion of making a foodstore, since Mr English observed that after clearing their tank of its living contents, as they always did in the course of a night, there were always to be found in the morning seven or eight small fishes piled neatly in some high, dry corner; and, as already mentioned, Mr Cocks found that worms were disabled and stored for future use.

Mrs Brightwen fed two upon the heads of fowls. She remarks that "there is hardly any animal in England so fierce and combative."² If the attention of one were attracted by a feather, "he always came out of his bed and sprang upon the feather like a little tiger, dragging it about and holding on with the grip of a bull-dog, so that one could lift him off the ground and keep him swinging a minute in the air."

Mr Cocks, who writes³ me that water shrews, being much the largest and strongest of the three British species, are more easily transferred from a wild life to a cage, has published a lively account of one which lived in his care for a day over eight months.⁴ Having been caught on 8th August, she gave birth "to a litter of four or five young during that night; they were blind and naked, and hardly larger than common house-flies, not nearly so large as bluebottles. She had had no time to prepare a nest, and after taking every care of them for two whole days, she ate them during the third night.

"Up to the time of writing, she has thriven on a 'diet of worms,' occasionally varied by a beetle, grub, moth, etc., and captured a fly which incautiously came of its own accord within

¹ *Field*, 3rd October 1863, 345.

² *Op. cit.*, 124.

³ Amplifying his account in *Vic. Co. Hist.*, *Buckinghamshire*.

⁴ Another lived for several months.

reach. A cockchafer was evidently considered a great (in both senses) prize, and she attacked it standing on three legs, one or other forepaw in turn being held raised, ready for action perhaps in case the victim resented being eaten piecemeal. It is amusing to watch her with a large worm when the latter is lively; the encounter then becomes heroic. She does not care for snails so long as the worms continue in such plenty. Of these I reckon that she eats quite once and a half her own bulk daily, and fully twice her own weight. The amount which passes from her, consisting chiefly of the earth contained in the worms, is on a correspondingly surprising scale. When excited she utters a rather shrill chatter, which is always, so far as I have noticed, sustained for half a minute or so, and never limited to a single note. As may be expected from the elongated, delicate snout, the shrews hunt their prey by scent. This specimen raises its long flexible nose nearly straight up, and bends it on itself rapidly from side to side, and very quickly discovers the whereabouts of a worm. When yawning, the flexible nose is turned considerably up—nearly to a right angle with the gape, and the upper incisor teeth then show as of surprising length."

The female Water Shrew, which is about the same size as the male, constructs a nursery for her young in a cavity filled with moss or herbs and placed at the end of a burrow, which, like the ordinary non-breeding tunnels, may have more than one opening, either above or below the surface of the water. But probably no one plan prevails to the exclusion of others, and Mr Millais, who took the trouble to have the galleries belonging to a colony dug out, found them to constitute a very elaborate system.

The young, which usually number from five to eight, make their appearance after a period of gestation, computed by Blasius at about three weeks. They grow so rapidly that by the time they reach the age of five or six weeks they are able to cater for themselves and to leave their mother.¹ It is probable that more than one litter sees the light each summer, the first in May or June and the last in September, on the 5th of which month Mr Rope² caught a large pregnant female.

¹ Blasius.

² *Zoologist*, 1900, 477.

Mr Millais had another on the 15th of the same month, and Mr W. Eagle Clarke on the same date obtained one in the nursing condition from Peeblesshire, while Blasius states that he twice saw the young on foot in late summer. Mr Adams caught a nursing female on 2nd October 1909.¹

The playfulness of young water shrews has often come under the notice of naturalists, and has been most graphically described by Mr Hodgson,² who watched a family of seven, being five young and two parents. "At the termination of a drain, where it emptied into an open water-course, was the entrance to their burrow. The field was in grass at the time and depastured with cattle. In a semicircle round their hole were a number of grass-covered runs, artistically arranged with the view apparently of forming a first-class recreation ground. A number of paths, wide enough only to accommodate a single shrew, radiated from the burrow as a centre, each extending about 7 or 8 feet in length. These were crossed by parallel semicircular tracks about a foot apart, the entire ground plan giving much the idea of a geometric spider's web cut in half. Along these tracks, lengthwise and crosswise indiscriminately, the youngsters chased each other with almost lightning speed. Should any two of their number chance to 'foreset' each other, there was a squabble, and much shrill recrimination resulted. When tired with racing long, they would suddenly scuttle into the burrow, only to return in a few minutes and renew their frantic exertions."

It is not known when the little family disperses or how long the young remain with their parents. It seems clear that the parents do not separate before or after the birth of their offspring, and it is very probable that the family party, as in the case of some other small mammals, may remain together for some little time, perhaps even for months. Probably, also, the breeding season brings these shrews together in companies, which would account for the party of nine or ten encountered by the late Canon H. B. Tristram³ on 6th May, as well as for a concourse of twenty or thirty observed in Yorkshire by Mr W. B. Arundel on the 10th of the same month.⁴

¹ *In lit.* ² *Trans. Cumberland and Westmorland Assoc.*, xi., 38-39, 1886.

³ *Zoologist*, 1853, 3905.

⁴ *Ibid.*, 1908, 189.

Apart from its colour, size, and the important cranial and dental characters, the greater size of the hind foot, measuring 16 to 18 as against 12 to 14 mm. in the Common Shrew, is probably the best absolute criterion of this species.

[Remains of a Desman from the late pliocene Forest-bed of Norfolk were first described by Owen, in 1846, under the name of *Palæospalax magnus*. Of late years they have been referred to the living "*Myogale*" = *Desmana moschata* of the Volga. If, as is quite probable, the fossils really belong to an extinct species, Owen's specific name, at all events, will have to be used.]

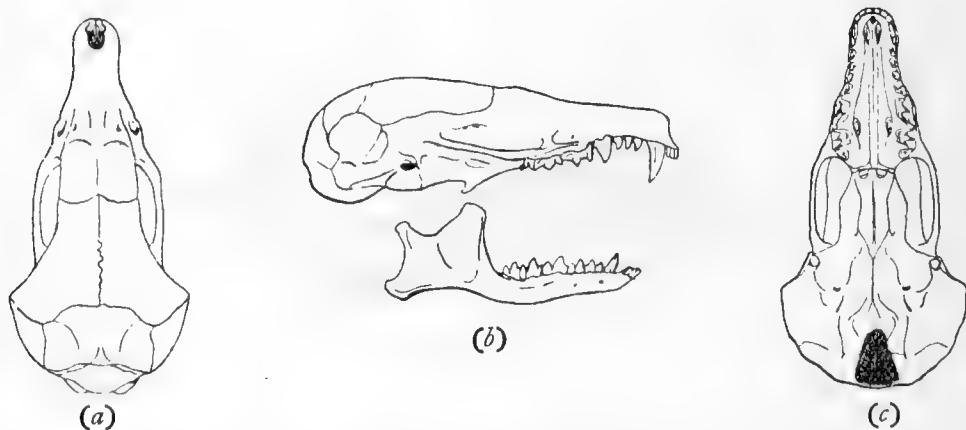


FIG. 27.—SKULL OF *Talpa europæa*:—(a) from above; (b) from the side; (c) from beneath. (Drawn by G. Dollman.)

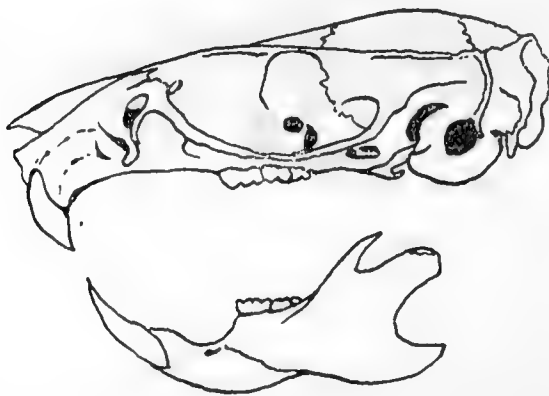


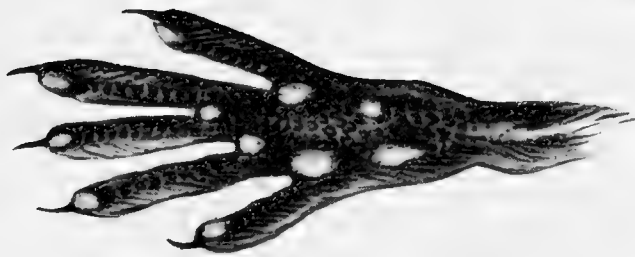
FIG. 28.—SKULL OF *Epimys rattus*, to show "rodent teeth" (life size).



(1)



(2)



(3)

WATER SHREW.

(1) LEFT FORE FOOT FROM BENEATH; (2) LEFT HIND FOOT FROM SIDE;
(3) LEFT HIND FOOT FROM BENEATH (magnified $2\frac{1}{2}$ times).



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